UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

THE PHYSIOGRAPHIC PROVINCES OF ALASKA

by

Clyde Wahrhaftig

This report has not been reviewed for conformity with U. S. Geological Survey standards and nomenclature.

January 1960

THE PHYSIOGRAPHIC PROVINCES OF ALASKA

By Clyde Wahrhaftig
U. S. Geological Survey, Menlo Park, California

Introduction

The wealth of recently accumulated geographic information on Alaska has made desirable a new classification of the state into physiographic divisions. Most of Alaska is now covered by topographic maps of high quality at scales of 1:63,360 and 1:250,000, prepared by multiplex methods from aerial photography. A classification made now is not likely to err through lack of knowledge of the geography and topography of the state; any changes it requires will reflect matters of judgment and taste, rather than ignorance. The accompanying classification was prepared intermittently between 1949 and 1959; most of the work was done between 1956 and 1959. It is hoped that it will bring about a clearer understanding of the geography of Alaska and will stimulate research into the history of development of Alaskan landforms.

The purpose of a physiographic classification of a region as large and diversified as Alaska is to subdivide it into areas that are homogeneous topographically and distinct from the areas around them, so that the physical appearance of the region can easily be apprehended and described. The boundaries of the physiographic units are therefore drawn where the topography changes character. The selection of the units was governed largely by the possibility of describing them accurately in short, general statements. If the units are too large, they cannot be described in general terms without doing violence to facts about their parts; and if the units are too small, important relations of topography, geology, and drainage cannot be described because the units do not include them.

Two of the major physiographic features of North America extend into Alaska: the Interior Lowlands and the North American Cordillera. The Arctic Coastal Plain is the only representative of the Interior Lowlands in Alaska. The North American Cordillera consists of three of the major divisions of Fenneman's classification, the Rocky Mountain System, the Intermontane Plateaus, and Pacific Mountain System, which form three parallel belts from the southern United States to Alaska. In Bostock's terminology, the Rocky Mountain System is known as the Eastern System and the Pacific Mountain System as the Western System. The names used here were applied to Alaska by Brooks (1906) and there seems to be no reason for abandoning them.

The major divisions and their boundaries are shown in the inset map in the upper left hand corner of Map 1. These in turn have been divided into 12 provinces, which are shown on Map 2 (Panel IV). The provinces have been subdivided into 60 sections, whose descriptions are given in the following pages. The numbers following the title of each province or section or the first mention in the text of each subsection correspond to the numbering of that area on Map 1 (Panel III). The illustrative photographs and maps are numbered in accordance with their numbering on Panels I and II, for the Arctic Coastal Plain, Rocky Mountain System, and Intermontane Plateaus, and on Panels V and VI for the Pacific Mountain System.

Two sections, the Old Crow Lowland (8) and the Duke Depression (50) are not described in the accompanying text. These lie very largely in Canada, and send very small prongs into Alaska. Descriptions for these areas are given by Bostock (1948).

The descriptions that follow include, for each area, a brief sketch of its topography, some salient features of the drainage, statements on the lakes, glaciers, and permafrost, and a condensed account of the geology as it affects physiographic development. These statements are based on the literature dealing with the geology and geography of Alaska, chiefly publications of the U. S. Geological Survey; on topographic maps and aerial photographs; and to a very large extent, especially for the geology, on unpublished information freely given by my colleagues of the Alaskan and Military Geology Branches of the Geological Survey whose names appear in the lower right hand corner of Map 1.

Although the basis for selecting the units is largely topographical, a major use of the classification is to deduce the history of the development of the topography, in order to understand why there should be mountains in one place and valleys in another. Such a history is necessarily geologic, and the geologic structure cannot be entirely neglected, as it is important in determining which areas shall be designated physiographic units. For example, the Upper Matanuska Valley and the Broad Pass Depression are shown as physiographic units because they are structurally controlled troughs, although many valleys that bear no relation to structure are not considered physiographic units although they are just as wide.

The division follows the scheme used for the physical divisions of the United States (Fenneman, and others, 1946), in which the great physiographic features of North America were broken into major divisions, each major division into provinces, and each province into sections. In addition, in the classification of Alaska some subdivision of sections into subsections has been necessary. As far as possible, the boundary lines were made to correspond with those of Bostock (1948) for the Canadian Cordillera, so that the physiographic units would match across the international boundary. Bostock's names were used for the units unless Alaskan names had already appeared in the literature or seemed more appropriate. Bostock's grouping into units corresponding to provinces and major divisions could not be adhered to in all areas.

REFERENCES

Bostock, H. S., 1948, Physiography of the Canadian Cordillera, with special reference to the area north of the Fifty-Fifth Parallel: Canada Geol. Survey Mem. 247, 106 p.

Brooks, A. H., 1906, The Geography and Geology of Alaska: U. S. Geol. Survey Prof. Paper 45, 327 p.

Fenneman, N. M., 1946 (in cooperation with the Physiographic Committee of the U. S. Geological Survey), Physical Divisions of the United States; map published by the U. S. Geological Survey.

ARCTIC COASTAL PLAIN (1)

General topography

The Arctic Coastal Plain is a smooth plain rising imperceptibly from the Arctic Ocean to a maximum altitude of 600 feet at its southern margin. The coastline makes little break in the profile of the coastal plain and shelf, and the shore is generally only 1-10 feet above the ocean; the highest coastal cliffs are only 50 feet high. The Arctic Coastal Plain province is divided into the Teshekpuk (1a) and White Hills (1b) sections. Scattered groups of low hills rise above the plain in the White Hills section; the Teshekpuk section is flat. Locally an abrupt scarp 50-200 feet high separates the coastal plain from the Arctic foothills. Pingoes, which are ice-cored gravel mounds 20-230 feet high, are locally sufficiently abundant to give an undulatory skyline. The part of the coastal plain between the Kuk and Colville Rivers has scattered longitudinal dunes 10-20 feet high trending N. 55°-75° E.

Drainage

The Arctic Coastal Plain is very poorly drained. It is crossed by rivers rising in highlands to the south. Rivers west of the Colville River meander sluggishly in valleys incised 50-300 feet; those east of the Colville cross the plain in braided channels, have built large alluvial fans, and are building deltas into the Arctic Ocean.

Lakes

The Teshekpuk section of the Coastal Plain province is covered by longitudinal thaw lakes oriented N. 15° W.; these range from a few feet to 9 miles long, are from 2 to 20 feet deep, and are oval or rectangular in shape. Lakes expand about 1 meter per year in places, and several generations of drained lake basins may be seen. (See Map 9.)

Glaciers and permafrost

There are no glaciers. The entire land area is underlain by permafrost at least 1,000 feet thick. The permafrost table (base of zone of summer thaw) is 1/2 to 4 feet below the surface. A network of ice-wedge polygons covers the coastal plain; these are in tetragonal patterns in the drained lake basins and in crudely hexagonal patterns elsewhere.

Geology

The Teshekpuk Lake section is underlain by 10-150 feet of unconsolidated Quaternary marine sediments resting on nearly flat Cretaceous sedimentary rocks with coal beds. The White Hills section contains, in addition, lower Tertiary sediments.

ARCTIC FOOTHILLS (2)

General topography

The Arctic Foothills consist of rolling plateaus and low linear mountains; they are divided into two sections. The northern section (2a) rises from 600 feet on the north to 1,200 feet on the south, and has broad east-trending ridges, dominated locally by mesa-like mountains. The southern section (2b) is 1,200-3,500 feet in altitude, with local relief of as much as 2,500 feet, and is characterized by irregular buttes, knobs, mesas, and east-trending ridges, with intervening gently undulating tundra plains. (See Photos 3 and 4.)

Drainage

The Arctic Foothills are crossed by north-flowing rivers from sources in the Brooks Range. The Colville River, the largest stream, has an anomalous east-trending course for 220 miles along the boundary between the northern and southern sections. Most streams have swift braided courses across broad gravel flats that are locally covered with *aufeis* in winter.

Lakes

A few thaw lakes are present in river valleys and on some divides. The upper valleys of major rivers from the Brooks Range contain many morainal lakes.

Glaciers and permafrost

There are no glaciers. The entire area is underlain by permafrost. Ice-wedges, stone stripes, polygonal ground, and other features of a frost climate are common.

Geology

The northern section is underlain by Cretaceous sedimentary rocks deformed into long linear folds of Appalachian type. Differential erosion of these rocks has produced the linear ridge topography. The southern section is underlain by diverse sedimentary rocks of Devonian to Cretaceous age, with mafic intrusives, all tightly folded and overthrust to the north. A pre-glacial gravel-covered pediment surface is preserved on some divides between north-flowing rivers. Hummocky morainal ridges border most of the large valleys issuing from the central Brooks Range.

ARCTIC MOUNTAINS PROVINCE

The Arctic Mountains province consists of mountains and hills carved chiefly in folded and overthrust Paleozoic and Mesozoic sedimentary rocks. It is divided into the following sections:

De Long Mountains (3); Lowlands of the Noatak (4); Baird Mountains (5); Central and Eastern Brooks Range (6).

DE LONG MOUNTAINS (3)

General topography

The central part of the De Long Mountains consists of rugged glaciated ridges 4,000-4,900 feet in altitude, with a local relief of 1,500-3,000 feet. Narrow even-crested ridges in the lower eastern and western parts rise to 3,000-4,000 feet. Many passes about 3,500 feet in altitude cross the range. The north boundary with the Arctic Foothills is irregular and indistinct, but the south front is abrupt.

Drainage

Streams from the De Long Mountains flow south and west to the Noatak River and the Chukchi Sea and north to the Arctic Ocean. The drainage divide is at the north edge of the mountains. Asymmetry of passes, barbed drainage, wind gaps, perched tributaries, and abandoned valley systems suggest that the divide has moved northward by stream capture.

Lakes

There are no lakes in the De Long Mountains.

Glaciers and permafrost

There are no glaciers in the De Long Mountains. The entire area is underlain by permafrost.

Geology

The De Long Mountains consist of folded and faulted sedimentary rocks of Devonian to Cretaceous age, intruded by massive diabase sills that are the chief cliff-forming units; structural trends are westerly in the eastern and northern mountains, and bend to southwesterly in the southwestern part. The eastern and northern De Long Mountains are a great sheet thrust north over the rocks of the Arctic Foothills.

LOWLANDS OF THE NOATAK (4)

General topography

Two broad lowlands surrounded by hills lie along the Noatak River, and are separated by a rolling upland. The Mission Lowland (4a) is a broad tundra flat, with thaw lakes and pingoes 25-300 feet high, crossed by the forested flood plain of the Noatak River, and merging with the surrounding foothills by silt uplands intricately dissected by thaw sinks. The Aniuk Lowland (4b) is an irregular rolling plain that slopes gradually upward on the south to merge with a subsummit upland in the Baird Mountains. The intervening upland is the Cutler River Upland (4c).

Drainage

The two lowlands and Cutler River Upland are drained entirely by the Noatak River, which rises in the western part of the Schwatka Mountains. The Noatak crosses the Cutler River Upland and the Igichuk Hills south of the Mission Lowland by narrow cliffed gorges a few hundred feet deep.

Lakes

The Mission Lowland has numerous thaw lakes. There are scattered morainal and thaw lakes in the Aniuk Lowland.

Glaciers and permafrost

There are no glaciers. The entire region is underlain by permafrost, and pingoes abound in the Mission Lowland.

Geology

Bedrock geology beneath the lowlands is probably similar to that of surrounding uplands and mountains. The entire valley of the Noatak was probably glaciated in pre-Wisconsin time, but glaciers of Wisconsin time occupied only part of the Aniuk Lowland and reached only the north edge of the Mission Lowland. The depth of alluvial fill in the lowlands is unknown. Rounded gravel is reported 850 feet above the Noatak in the Cutler River Upland, and the course of the Noatak across the upland may be superposed.

BAIRD MOUNTAINS (5)

General topography

Moderately rugged mountains with rounded to sharp summits 2,500-3,000 feet in altitude rise abruptly from lowlands on the south and west, to a subsummit upland along the crest of the Baird Mountains; this subsummit upland slopes gently northward and merges with the Aniuk Lowland and Cutler River Upland. Scattered groups of higher mountains (3,500-4,500 feet in altitude) rise above the subsummit upland, and were centers of glaciation in late Pleistocene time. The boundary with the Schwatka Mountains on the east is drawn where the relief increases abruptly eastward, and is indistinct.

Drainage

The Baird Mountains are drained by streams that flow north to the Noatak and south to the Kobuk. The south-flowing streams head in narrow ravines with steep headwalls several hundred feet high, incised in broad flat passes that are the beheaded parts of north-draining valleys. This relationship indicates that the divide is migrating to the north by headward erosion.

Lakes

There are no lakes in the Baird Mountains.

Glaciers

There are no glaciers in the Baird Mountains.

Geology

Schist, quartzite, and limestone, of Paleozoic age, make up most of the Baird Mountains. Structural trends are easterly, and the internal structure is probably anticlinorial. Differential erosion of a northeast-striking doubly-plunging anticline involving limestone and volcanic rocks along the northwest border of the range has produced prominent northeast-trending ridges.

CENTRAL AND EASTERN BROOKS RANGE (6)

General topography

The central and eastern Brooks Range is a wilderness of rugged glaciated east-trending ridges that rise to generally accordant summits 7,000-8,000 feet in altitude in the north and 4,000-6,000 feet in altitude in the south. The easterly grain to the topography is due to belts of hard and soft sedimentary and volcanic rocks. The mountains have cliff-and-bench slopes characteristic of glacially eroded bedded rocks. Abrupt mountain fronts face foothills and lowlands on the north. (See Map 10 and Photos 1, 2, and 3.)

Drainage

The drainage divide between the Bering Sea and Arctic Ocean drainages is near the north edge of the range, west of long. 149° W. and in the center of the range east of long. 149° W. The major rivers flow north to the Arctic Ocean and south to the Yukon, Koyukuk, and Kobuk Rivers in flat-floored glaciated valleys 1/2 to 2 miles wide, and have a broad dendritic pattern. Minor tributaries flow east and west parallel to the structure, superposing a trellised pattern on the dendritic pattern of the major drainage.

Lakes

Large rock-basin lakes lie at the mouths of several large glaciated valleys on the north and south sides of the range. The Brooks Range in general is characterized by a paucity of lakes for a glaciated region.

Glaciers

Small cirque-glaciers are common in higher parts of the range, in the Schwatka Mountains and in mountains around Mount Doonerak. Firn line is about 6,000 feet in north-facing cirques and about 8,000 feet in south-facing cirques. Valley glaciers 5 miles long are fed from icecaps in the Romanzof Mountains.

Geology

The Central and Eastern Brooks Range is composed chiefly of Paleozoic limestone, shale, quartzite, slate, and schist. Northeast of the Sagavanirktok River the Paleozoic rocks are in faulted folds overturned to the north. Elsewhere they are in giant plates and nappes thrust to the north. The deformation is of Laramide age. The north front of the range is made of light-colored cliff-forming Mississippian limestone. (See Photos 2 and 3.)

Rocks south of lat 68° N. are metamorphosed. Granitoid masses underlie the higher parts of the Schwatka Mountains (6a) and Romanzof Mountains (6b), both of which rise to 8,500-9,000 feet.

NORTHERN PLATEAUS PROVINCE

The northern plateaus province consists of uplands and lowlands carved chiefly in Paleozoic and Precambrian rocks. It is divided into the following sections:

Porcupine Plateau (7); Old Crow Plain (8)*; Ogilvie Mountains (9); Eagle Trough (10); Yukon-Tanana Upland (11); Northway-Tanacross Lowland (12); Yukon Flats Section (13); Rampart Trough (14); Kokrine-Hodzana Highlands (15); Ambler-Chandalar Ridge and Lowland Section (16).

* Not described

PORCUPINE PLATEAU (7)

General topography

Low ridges with gentle slopes and rounded to flat summits 1,500-2,500 feet in altitude dominate the topography of the Porcupine Plateau. A few domes and mountains rise to 3,500 feet. Valley floors are broad and valley patterns irregular, with many imperceptible divides. Thazzik Mountain (7a) in the extreme west, a rugged glaciated mountain group, rises to 5,800 feet.

Drainage

The entire area, except the extreme northeast, is drained by tributaries of the Yukon. The Chandalar, Sheenjek and Colleen Rivers rise in the Brooks Range and flow southward across the plateau in broad valleys floored with moraines and outwash terraces. The Porcupine River crosses the plateau in a narrow cliff-lined canyon 50-500 feet deep. The Black and Little Black Rivers, which drain the southeastern part of the area meander through broad irregular flats.

Lakes

A few moraine-dammed lakes lie in glaciated passes and valleys along the north margin of the plateau. The largest of these is Old Man Lake, 5 miles long and 2 miles wide. Scattered thaw lakes occur in lowlands and low passes.

Glaciers and permafrost

There are no glaciers. The entire area is underlain by continuous permafrost.

Geology

The northern part is underlain by crystalline schist, granite, quartzite, slate, and mafic rocks, probably mostly Paleozoic in age; the southeastern part is underlain by moderately deformed Paleozoic and Mesozoic sedimentary rocks. Basin-like areas of Tertiary rocks and flat-lying Cenozoic flows occur along the Porcupine River.

OGILVIE MOUNTAINS (9)

General topography

The Ogilvie Mountains have sharp crestlines, precipitous slopes, and deep narrow valleys; they rise to 5,000 feet in altitude, and local relief is as much as 4,100 feet. The ridges are interconnected, and passes are few. The narrow valleys are interrupted by gorges where rivers cross cliff-forming layers of rock.

Drainage

The Ogilvie Mountains are drained by the Kandik, Nation, and Tatonduk Rivers, all tributaries of the Yukon.

Lakes

No lakes are known in the Ogilvie Mountains.

Glaciers and permafrost

There are no glaciers. Most of the area is underlain by permafrost.

Geology

Moderately folded and faulted sedimentary and volcanic rocks ranging in age from late Precambrian to Triassic make up the mountains. Some formations of limestone, quartzite, and greenstone are in massive cliff-forming beds.

EAGLE TROUGH (10)

General topography

The Eagle Trough is the westward continuation of the Tintina Valley of Yukon Territory. It is a structurally controlled trough with low rounded ridges and terraced valleys. Relief is 1,000-1,500 feet, and ridges rise to 2,000-2,500 feet in altitude. Rugged hills on the north separate the Eagle Trough from the canyon of the Yukon River, and an abrupt mountain wall rises above the trough on the south.

Drainage

The Eagle Trough is drained chiefly by small north-flowing streams that rise in the upland to the south and have superposed courses to the Yukon in narrow canyons across hills of resistant rocks on the north.

Lakes

There are no large lakes in the Eagle Trough.

Glaciers and permafrost

The area contains no glaciers, but is in the region of discontinuous permafrost.

Geology

The Eagle Trough is underlain by a belt of highly deformed, easily eroded continental sedimentary rocks of early Tertiary age, in probable fault contact with the metamorphic and granitic rocks of the Yukon-Tanana Upland on the south and with well-consolidated Paleozoic and Mesozoic sedimentary rocks of the Ogilvie Mountains on the north. The valleys contain many small gold placer deposits, probably reworked from alluvial gold in the Tertiary rocks.

YUKON-TANANA UPLAND (11)

General topography

The Yukon-Tanana Upland is the Alaskan equivalent of the Klondike Plateau in Yukon Territory. Rounded even-topped ridges with gentle side-slopes characterize this region of broad undulating divides and flat-topped spurs.(See Photos 6 and 9.) In the western part (11a) these rounded ridges trend northeast to east; they have ridge-crest altitudes of 1,500-3,000 feet, and rise 500-1,500 feet above adjacent valley floors. They are surmounted by compact rugged mountains 4,000-5,000 feet in altitude. (See Map 11.) Ridges in the eastern part (11b) have no preferred direction, are 3,000-5,000 feet in altitude, with some domes up to 6,800 feet, and rise 1,500-3,000 feet above adjacent valleys. (See Photo 6.) Valley floors in the western part are generally flat, alluvium floored, and 1/4 to 1/2 mile wide to within a few miles of headwaters. Streams in the eastern part that drain to the Yukon flow in narrow V-shaped terraced canyons, but the headwaters of the Fortymile and Ladue Rivers are broad alluvium-floored basins.

Drainage

The entire area is in the Yukon drainage basin. Streams flow south to the Tanana and north to the Yukon. Most streams in the western part follow courses parallel to the structure, and several streams have sharp bends involving reversal of direction around the ends of ridges of hard rocks. Drainage divides are very irregular. Small streams tend to migrate laterally southward. (See Map 11.)

Lakes

The few lakes in this region are mainly thaw lakes in valley floors and on low passes.

Glaciers and permafrost

There are no glaciers. The entire province is underlain by discontinuous permafrost. Periglacial mass-wasting is active at high altitudes. Ice-wedges lace the frozen muck of valley bottoms.

Geology

A belt of highly deformed Paleozoic sedimentary and volcanic rocks with prominent limestone units, overthrust and overturned to the north, extends along the north side of the upland. The rest of the upland is chiefly Precambrian schist and gneiss, with scattered small elliptical granitoid intrusions in the northwest, and large irregular batholiths making up much of the southeast part. A thick mantle of windborne silt lies on the lower slopes of hills in the western part. The deep stream gravels in the valleys of the western part are overlain by thick accumulations of muck. Alluvial deposits of gold and other metals abound throughout the upland.

NORTHWAY-TANACROSS LOWLAND (12)

General topography

The Northway-Tanacross Lowland consists of three small basins, separated by screens of low rolling hills. The two basins along the north side of the lowland are nearly level plains, broadly oval in plan. Scattered longitudinal dunes mark the floor of the eastern one of these basins; the third basin, on the southeast, is a gently rolling moraine-covered plain.

Drainage

The entire lowland is drained by the Tanana River, which may have captured it in early Pleistocene time, for the drainage divide with the Yukon is only 2-5 miles north of the Tanana and the north tributaries of the Tanana are steep barbed streams. The headwaters of the Yukon drainage north of the divide are underfit streams in broad valleys that head in wind gaps.

The main tributaries of the Tanana rise in glaciers in mountains to the south, and their deposits of outwash have pushed the Tanana against the north side of the lowland. The upper courses of these streams are swift and braided; their lower courses and the course of the Tanana are sluggish and meandering.

Lakes

Large lakes in reentrants in the surrounding hills may be caused by alluviation of the lowland. Thaw lakes abound in areas of fine alluvium, which are as much as 70 percent water. Oxbow lakes and morainal ponds are also present.

Glaciers and permafrost

The lowland has no glaciers; it is in the region of discontinuous permafrost.

Geology

The basins are mantled with outwash gravel, silt, and morainal deposits. The two northern basins were probably occupied by a lake dammed by a glacier at Cathedral Rapids. Tertiary rocks have been reported on the north side, and may extend beneath the Quaternary deposits. Bedrock hills are Precambrian schist and Mesozoic granitoid intrusions. The Taylor Highway north of Fortymile passes through a dune field.

YUKON FLATS SECTION (13)

General topography

The central part of the Yukon Flats section consists of marshy lake-dotted flats rising from 300 feet in altitude at the west end to 600-900 feet on the north and east. The northern part of the flats is made up of the gently sloping outwash fans of the Chandalar, Christian, and Sheenjek Rivers; the southeastern part of the flats is the broad gentle outwash fan of the Yukon River. Other areas are nearly flat flood plains. Rolling silt- and gravel-covered marginal terraces rise above the flats with sharp escarpments 150-600 feet high, and slope gradually upward to altitudes of about 1,500 feet at the base of surrounding uplands and mountains. Their boundaries with surrounding uplands and mountains are gradational.

Drainage

The Yukon Flats Section is drained by the Yukon River, which has a braided course southeast of the bend at Fort Yukon and a meandering course, with many sloughs, southwest of the bend at Fort Yukon. Most tributaries rise in surrounding uplands and mountains and have meandering courses through the flats.

Lakes

Thaw lakes are abundant throughout the flats. Thaw lakes and thaw sinks are common on the marginal terraces.

Glaciers and permafrost

There are no glaciers. Permafrost probably underlies most of the section except rivers, recently abandoned meander belts, and large thaw lakes.

Geology

Escarpments bounding the flats expose well-consolidated or crystalline rocks of Paleozoic and possibly Mesozoic age. The marginal terraces are capped with gravel on which rests a layer of windborne silt. The thickness of alluvium and outwash beneath the flats is unknown.

RAMPART TROUGH (14)

General topography

The Rampart Trough is a structurally controlled depression with gently rolling topography 500-1,500 feet in altitude, incised 500-2,500 feet below highlands on either side. Terraces on tributaries of the Yukon near Rampart are 20 feet, 100 feet, 150 feet, 250 feet, and 500 feet above stream level.

Drainage

The Yukon River enters the east end of the trough through a narrow rocky gorge, and swings in broad bends from side to side of the trough within a narrow flood plain. Near the southwest end a ridge of hard rock separates the Yukon from the trough. Short tributaries rise in hills to the south, flow across the trough, and through the bedrock ridge on its north side to the Yukon. The Yukon and its tributaries appear to be superimposed from a surface at least 1,500 feet in altitude.

Lakes

Scattered thaw lakes lie on the Yukon flood plain and elsewhere.

Glaciers and permafrost

The Rampart Trough contains no glaciers. Permafrost underlies all the lowland except the Yukon flood plain.

Geology

The Rampart Trough was eroded along a tightly folded belt of soft continental coal-bearing rocks of Tertiary age. Hard rock hills and the surrounding uplands are metasedimentary and metavolcanic rocks of Mississippian age that strike about N. 60° E. and are cut by granitoid intrusions.

KOKRINE-HODZANA HIGHLANDS (15)

General topography

The Kokrine-Hodzana Highlands consist of even-topped rounded ridges rising to 2,000-4,000 feet, surmounted by isolated areas of more rugged mountains. The Ray Mountains (15a), rising to 5,500 feet, have cirques and glaciated valleys, and craggy cliffed tors rise abruptly from broad ridgetops. Valleys have alluviated floors to within a few miles of their heads.

Drainage

The irregular drainage divide between the Yukon and its large tributary, the Koyukuk, passes through these highlands. Drainage to the Yukon is by way of the Hodzana, Tozitna, Melozitna, and many shorter streams. Drainage to the Koyukuk is by the Kanuti River and the South Fork of the Koyukuk.

Lakes

There are a few thaw lakes in lowland areas and a few lakes in north-facing cirques in the Kokrine Hills (15b) and the Ray Mountains.

Glaciers and permafrost

There are no glaciers. The entire area is probably underlain by permafrost. This is a classic area for altiplanation terraces, stone polygons, and other periglacial phenomena.

Geology

The highlands are underlain chiefly by Paleozoic and Precambrian schist and gneiss with a northeast-trending structural grain, cut by several granitoid intrusions, the largest of which is the granite batholith that upholds the Ray Mountains. Small placers of tin and gold occur in the southern part.

AMBLER-CHANDALAR RIDGE AND LOWLAND SECTION (16)

General topography

This section consists of one or two east-trending lines of lowlands and low passes 3-10 miles wide and 200-2,000 feet above sea level, bordered on the north by the abrupt front of the Brooks Range. Along the south side is a discontinuous line of rolling to rugged ridges, 25-75 miles long and 5-10 miles wide, rising to 3,000-4,500 feet in altitude. Some of these ridges were intensely glaciated. Within the lowlands are east-trending ridges 5-10 miles long.

Drainage

The western part of the section is drained by tributaries of the Kobuk River, the central part by the Koyukuk and its tributaries, and the eastern part by the Chandalar. Most streams flow south out of the Brooks Range across both the lowlands and the ridges, to lowlands farther south. The drainage was probably superimposed, but may have been disoriented later by glaciers. The Chandalar River flows eastward along the eastern part of the trough.

Lakes

Several large lakes fill ice-carved rock basins in deep narrow canyons across the southern ridge. Areas of ground and end moraine contain many ponds. The flood plains of the major streams have thaw lakes and oxbow lakes.

Glaciers and permafrost

The area contains no glaciers, but is underlain by continuous permafrost.

Geology

The ridges are upheld in part by massive metabasalt of Mesozoic(?) age. The lowlands are underlain largely by Cretaceous sedimentary rocks, folded into synclines. Pleistocene glaciers from the Brooks Range extended across the lowland and through passes in the line of ridges.

WESTERN ALASKA PROVINCE

The Western Alaska province consists of uplands and lowlands underlain chiefly by folded and faulted Cretaceous rocks. It is divided into the following sections:

Kanuti Flats (17); Tozitna-Melozitna Lowland (18); Indian River Upland (19); Pah River section (20); Koyukuk Flats (21); Kobuk-Selawik Lowland (22); Selawik Hills (23); Buckland River Lowland (24); Nulato Hills (25); Tanana-Kuskokwim Lowland (26) Nowitna Lowland (27); Kuskokwim Mountains (28); Innoko Lowlands (29); Nushagak-Big River Hills (30); Holitna Lowland (31); Nushagak-Bristol Bay Lowland (32).

KANUTI FLATS (17)

General topography

The Kanuti Flats are an irregularly-shaped lake-dotted plain 400 to 1,000 feet in altitude that merges with low surrounding hills. Scattered low irregular hills rise in the central part of the plain, which is crossed by the forest-covered meander belts of the Koyukuk and Kanuti Rivers.

Drainage

The Kanuti Flats are drained by the Koyukuk River and its tributaries. The Kanuti River, which drains the southern part of the plain, flows through a narrow canyon in the Indian River Upland before joining the Koyukuk River.

Lakes

There are numerous thaw lakes, some as large as 2 miles across. Some parts of the flats are more than 50 percent lake surface.

Glaciers and permafrost

The flats contain no glaciers. The area is underlain by permafrost except beneath large lakes, rivers, and recently formed flood plains.

Geology

The geology of the Kanuti Flats is unknown.

TOZITNA-MELOZITNA LOWLAND (18)

General topography

The Tozitna-Melozitna Lowland is a long narrow rolling plain, 5-10 miles wide, at the heads of the Tozitna and Melozitna Rivers.

Drainage

The lowland is drained by the Tozitna and Melozitna Rivers, which flow south from the lowland in narrow gorges across the Kokrine-Hodzana Highlands to the Yukon River.

Lakes

The lowland contains numerous thaw lakes.

Glaciers and permafrost

The area has no glaciers; it is in the region of discontinuous permafrost.

Geology

Nothing is known of the geology of the Tozitna-Melozitna lowland.

INDIAN RIVER UPLAND (19)

General topography

Groups of low gentle ridges with rounded accordant summits at 1,500-2,000 feet altitude are interspersed with irregular lowlands and broad flat divides. The ridges in the southeast part are generally parallel and trend northeasterly; ridges in the northwestern part have irregular trends. A few mountains rise to 4,000 feet. The Koyukuk and Kanuti Rivers cross the upland in narrow canyons a few hundred feet deep.

Drainage

Most of the Indian River Upland is drained by the Koyukuk River and its tributaries. The northwest corner drains to the Kobuk River and the southeastern part drains by the Melozitna River to the Yukon. Many of the streams have extremely irregular courses.

Lakes

Numerous thaw lakes, the largest 2-1/2 miles across, are in the lowlands, valleys, and broad passes.

Glaciers and permafrost

There are no glaciers. The entire land area, except recent flood plains, is underlain by permafrost, and periglacial processes predominate. Altiplanation terraces are common at high altitudes.

Geology

The Indian River Upland is underlain chiefly by folded sedimentary and volcanic rocks of Mesozoic age. Sandstone, shale, and conglomerate predominate. These are intruded by small granitoid stocks, and are overlain by remnants of flat-lying lavas of Tertiary or Quaternary age. Structural trends are northeasterly in the southeastern part, but are poorly defined in the northern part.

PAH RIVER SECTION (20)

General topography

The Pah River section is an area of diversified topography. Compact groups of hills and low mountains 20-40 miles long and rising to 4,000 feet are surrounded by rolling plateaus 500-1,500 feet high and broad lowland flats 5-10 miles across. The lower parts of the mountain groups consist of gently rounded ridges; their higher glaciated parts have broad shallow cirques with flaring walls. (See Photo 7.)

Drainage

The north and west parts of the Pah River section drain to the Selawik and Kobuk Rivers. The south and east parts drain via the Huslia and Hogatza Rivers to the Koyukuk. The major streams meander sluggishly through the broad lowlands. The Pah River, which drains the Pah River flats (20b), flows north to the Kobuk through a narrow canyon across the Lockwood Hills (20a).

Lakes

Numerous thaw lakes lie in the lowland flats. The central part of the Pah River Flats is probably 50 percent lake surface. (See Photo 7.) A few small cirque lakes occur in the higher glaciated parts of the Lockwood Hills and the Zane Hills (20c).

Glaciers and permafrost

There are no glaciers. The entire region is underlain by permafrost, and periglacial erosion processes predominate. Altiplanation terraces are common below the level of glaciation in the Zane Hills and the Purcell Mountains (20d).

Geology

The Pah River section is underlain by Mesozoic volcanic and sedimentary rocks that are intensely deformed and locally contact metamorphosed, without strong persistent structural grain, and by Mesozoic granitoid stocks and batholiths.

KOYUKUK FLATS (21)

General topography

The central parts of the Koyukuk Flats are flat plains 5-20 miles wide, along the major rivers. The parts immediately adjacent to the rivers are meander belts 5-10 miles wide; the parts farther away are dotted by thaw lakes. Broad rolling silt plains, in part mantled by dunes and in part pocked by thaw sinks, stand 100-200 feet above these central plains and merge imperceptibly with the surrounding uplands. Several low bedrock hills rise from the center of the lowland. (See Map 12.)

Drainage

The Koyukuk Flats are drained by the Yukon River and its tributaries. The Yukon and Koyukuk Rivers join in this section. Streams meander wildly across the lowland, and have numerous meandering side sloughs. Lateral migration of meanders is as much as 75 feet per year, and elaborate patterns of bars and swales (meander scrolls) are left behind. (See Photo 11.)

Lakes

The meander belt has innumerable narrow meander-scroll lakes and some oxbow lakes; these are gradually silted by floods, and the newly formed ground freezes. Subsequently thaw lakes develop in the frozen ground and pass through a complicated cycle. Thaw lakes are abundant away from the rivers. (See Map 12, and the section on Unglaciated Lowlands.)

Glaciers and permafrost

No glaciers exist in the flats. All the land except recently formed flood plains is underlain by permafrost.

Geology

The surrounding uplands and bedrock hills are chiefly Cretaceous sedimentary rocks and older Mesozoic volcanic rocks, with some intrusives. Low basalt hills rise from the central part of the lowland. The plain is underlain by waterlaid and windborne silt. Sand dunes are common; a large barren area of active sand dunes lies in the northwest part. Northeast-trending scarplets and low rises that cross the lowland are presumably along active faults.

KOBUK-SELAWIK LOWLAND (22)

General topography

The Kobuk-Selawik Lowland consists chiefly of broad river flood plains and lake-dotted lowlands that pass at their seaward margins into deltas. The Baldwin Peninsula, that separates Hotham Inlet from Kotzebue Sound, is a rolling lake-dotted lowland with hills up to 350 feet in altitude, bordered by bluffs. The Waring Mountains (22a) are an east-trending group of low rounded hills less than 2,000 feet high. The upper valley of the Kobuk River is bordered by gravel and sand terraces 100-200 feet above river level that are dotted with thaw lakes and thaw sinks and, on the south side of the river, have large areas of both stabilized and active sand dunes.

Drainage

The lowland is drained mainly by the Kobuk and Selawik Rivers. Most streams are sluggish, meandering and of low gradient, with numerous side sloughs.

Lakes

The area around the Selawik River, in particular, has numerous large thaw lakes. Hotham Inlet and Selawik Lake are large bodies of water at sea level that are kept nearly fresh by the great outflow of the Selawik, Kobuk and Noatak Rivers.

Glaciers and permafrost

Glaciers are absent; most land area is underlain by permafrost. Pingoes are abundant in the lowland around the Selawik River.

Geology

Most of the lowland areas are underlain by morainal deposits, and by stream and lake deposits of unknown thickness. Baldwin Peninsula is probably the end moraine of a pre-Wisconsin glacial advance. Glaciers in Wisconsin time sent tongues into the upper valley of the Kobuk, but did not advance farther. The Waring Hills are underlain by Cretaceous sedimentary rocks.

SELAWIK HILLS (23)

General topography

The Selawik Hills are gentle hills with rounded to flat summits as much as 2,500 feet in altitude.

Drainage

The hills are drained by short streams that flow to the Buckland and Selawik Rivers.

Lakes

There are no lakes.

Glaciers and permafrost

There are no glaciers. The entire area is underlain by permafrost.

Geology

The Selawik Hills are underlain chiefly by Paleozoic and Mesozoic metavolcanic rocks and granitoid intrusive rocks. Quaternary volcanic rocks lie on the flanks.

BUCKLAND RIVER LOWLAND (24)

General topography

The Buckland River Lowland is a rolling lowland, with slopes of a few feet to a few hundred feet per mile, consisting largely of the original surfaces of lava flows.

Drainage

The lowland is drained mostly by the Buckland River. Tagagawik River drains the extreme eastern part, and the Koyuk River the southern prong.

Lakes

Few or no lakes exist in the Buckland River Lowland.

Glaciers and permafrost

There are no glaciers. The entire area is probably underlain by permafrost.

Geology

The lowland is underlain chiefly by flat-lying lava flows of Quaternary age, mantled by a thick layer of windborne silt.

NULATO HILLS (25)

General topography

The Nulato Hills consist, in general, of northeast-trending even-crested ridges 1,000-2,000 feet in altitude, with rounded summits and gentle slopes. Valleys are narrow, and have flat floors that are generally trenched in their upstream parts to depths of about 30 feet. Local relief is 500-1,500 feet. The texture of the topography is relatively fine; gullies are spaced 500-1,500 feet apart and second-order tributaries are 1/2-1 mile apart. (See Map 15.) Three highland areas of steeper ridges rise to about 4,000 feet.

Drainage

Streams on the east side of the hills flow to the Yukon and those on the west side to Norton Sound. Major streams are markedly parallel, flowing either northeast or southwest, and their courses are eroded along northeast-trending fault zones. Valley heads are generally connected by low passes eroded along the faults.

Lakes

There are a few thaw lakes in the valleys.

Glaciers and permafrost

There are no glaciers. The entire area is probably underlain by permafrost.

Geology

Almost all of the hills are composed of tightly folded sandstone, conglomerate, and shale of Cretaceous age. The folds strike about N. 45° E., but bend around to northerly trends in the northern part. The rocks are cut by northeast- and north-trending faults. A few mountains are underlain by post-Cretaceous intrusive and volcanic rocks. Older rocks, chiefly of volcanic origin, make up the hills in the extreme north and extreme south.

TANANA-KUSKOKWIM LOWLAND (26)

General topography

The Tanana-Kuskokwim lowland is a broad depression bordering the Alaska Range on the north, with surfaces of diversified origin. Coalescing outwash fans from the Alaska Range slope 20-50 feet per mile northward to flood plains along the axial streams of the lowland. Rivers from the range flow for a few miles at the heads of the fans in broad terraced valleys 50-200 feet deep. Semi-circular belts of morainal topography lie on the upper ends of some fans. (See Photo 10 and Map 18.) The flood plains of the Kuskokwim and Kantishna Rivers, and of the Tanana west of

Tolovana, are incised 50-200 feet below the level of the lowland. Several nearly level projections of the lowland extend into uplands on the north. Large fields of stabilized dunes cover the northern part of the lowland and lower parts of adjacent hills between Nenana and McGrath. (See Map 17.)

Drainage

The central and eastern part of the lowland is drained by the Tanana River, and the southwestern part by the Kuskokwim River. Braided glacial streams rising in the Alaska Range (Photo 8) flow north across the lowland at intervals of 5-20 miles. Outwash has pushed the axial streams--the Tanana, Kuskokwim, and Kantishna Rivers--against the base of hills on the north side. Tightly meandering tributaries of low gradient come in from the north.

Lakes

Thaw lakes abound in areas of fine alluvium. Thaw sinks are abundant in areas of thick loess cover.

Glaciers and permafrost

The lowland contains no glaciers. The entire area is a region of permafrost. Porous gravel at the heads of the outwash fans, however, has a deep water table and dry permafrost (ground perennially at temperatures below freezing but with no ice).

Geology

The outwash fans grade from coarse gravel near the Alaska Range to sand and silt along the axial streams. Areas north of the axial streams are underlain by thick deposits of "muck", a mixture of frozen organic matter and silt. Parts of the southwestern part of the lowland have thick loess cover, but the central and eastern parts are free of loess south of the Tanana River. Scattered low hills of granite, ultramafic rocks, and Precambrian schist rise through the outwash. Tertiary conglomerate in the foothills of the Alaska Range plunges beneath the lowland in a monocline, and the heads of the outwash fans may rest on a pediment cut across this conglomerate.

NOWITNA LOWLAND (27)

General topography

The Nowitna Lowland is a rolling silt-covered tableland from 250 to 900 feet in altitude, with a local relief of 50-250 feet and slopes of 100-150 feet per mile, into which the flat flood plains of the major rivers (valleys 1-1/2-10 miles wide) have been incised 150-300 feet. A line of gentle bedrock hills in the center rises to 1,500 feet. The tableland is pocked with thaw sinks. The part of the tableland south of the line of hills is covered with longitudinal and sigmoid dunes and has been dissected by steep-walled gullied canyons. (See Map 14.)

Drainage

The entire lowland is drained by the Yukon River, which follows the north boundary. The confluence of the Yukon and the Tanana is in the eastern part of the lowland. The southern part of the lowland is drained by the Nowitna, a tributary of the Yukon, and its tributaries. Parallel drainage of small tributaries of the Chitanana and other streams in silt uplands of the eastern part may be consequent upon the flanks of a recent upwarp. (See Map 13.)

Lakes

Oxbow lakes are common in the central parts of the meander belts. Thaw lakes abound in the marginal areas and throughout the silt- and dune-covered uplands.

Glaciers and permafrost

The area contains no glaciers; it is underlain by permafrost, except in recently abandoned flood plains.

Geology

Bedrock of the hills is similar to that of surrounding highlands--schist and gneiss on the west and Cretaceous sedimentary rocks on the east, all cut by granitoid intrusions. Tilted and faulted Tertiary and possibly Quaternary sediments are exposed on the south bank of the Yukon. Most of the lowland is covered by windborne silt and sand of unknown thickness. Depth of alluvium is at least 180 feet.

KUSKOKWIM MOUNTAINS (28)

General topography

The Kuskokwim Mountains are a monotonous succession of northeast-trending ridges with rounded to flat summits 1,500-2,000 feet in altitude and broad gentle slopes. (See Map 16.) Ridge crests north of the Kuskokwim River are accordant at about 2,000 feet, and are surmounted at intervals of

10-30 miles by isolated circular groups of rugged glaciated mountains 3,000-4,400 feet high. Valleys have flat floors 1-5 miles wide.

Drainage

The Kuskokwim Mountains are drained by tributaries of the Yukon and Kuskokwim Rivers. Major streams generally flow northeast or southwest along valleys that are probably controlled by faults; streams are fast and meandering and generally lie near the northwest walls of their valleys. The Kuskokwim River crosses the mountains in a gorge 100-400 feet deep incised in an older valley about 1,000 feet deep and 2-8 miles wide.

Lakes

Lakes are rare. There are oxbow and thaw lakes in the valleys and a few cirque lakes in the glaciated mountains.

Glaciers and permafrost

There are no glaciers. Permafrost underlies most of the area, and periglacial erosional processes predominate.

Geology

Most of the Kuskokwim Mountains are made of tightly folded Cretaceous rocks that strike northeast. Graywacke upholds the ridges and argillite underlies the valleys. The northeast and northwest parts are underlain by Paleozoic sediments and Precambrian schist. The isolated circular groups of high mountains are underlain by monzonitic intrusions and their surrounding hornfels aureoles. Flat-lying basalt caps the remnants of a mid-Tertiary erosion surface. Pleistocene and Recent block faulting has occurred south of the Kuskokwim River.

INNOKO LOWLANDS (29)

General topography

The Innoko Lowlands are a group of flat river flood plains, dendritic in pattern, whose bounding slopes are generally steep banks cut into the surrounding hills; in places, however, gentle silt-covered slopes merge with the surrounding hills.

Drainage

The Yukon River and a large tributary, the Innoko, cross these lowlands. The main part of the lowlands has a complex intersecting network of meandering sloughs of these two streams.

Lakes

Oxbow and meander-scroll lakes are abundant in recently abandoned flood plains and partly silted sloughs. Thaw lakes abound in old flood plains and on gentle silt-covered slopes. The lower parts of many tributaries from surrounding hills are dammed by alluvium from the Yukon and form narrow dendritic lakes.

Glaciers and permafrost

No glaciers exist in the lowlands. Much of the area is underlain by permafrost.

Geology

Bedrock geology is probably the same as that of the surrounding hills. The plains are mantled by river flood plain deposits and by windborne silt, which also extends up the slopes of surrounding hills.

NUSHAGAK-BIG RIVER HILLS (30)

General topography

The Nushagak-Big River Hills are largely rounded, flat-topped ridges rising to 1,500 feet on the west and 2,500 feet on the east; they have broad gentle slopes and broad, flat or gently sloping valleys. Local relief is 1,000-2,500 feet. Mountains in the northeast rise to 4,200 feet. Ridges trend northeastward in the eastern part, but have no preferred trend in the southwestern part.

Drainage

The northern part of the hills drains to the Kuskokwim River via the Big River, the Stony, Swift and Holitna Rivers; the southern part is drained by the Mulchatna and Nushagak Rivers. The rivers that rise from glaciers in the Alaska Range and flow across the hills, like the Stony and Swift, are braided turbid streams. Others, like the Holitna, are clear and meandering.

Lakes

A few thaw lakes are in some valleys. Ponds are abundant in the moraine-mantled eastern part of the hills.

Glaciers and permafrost

There are no glaciers. Most of the area is underlain by permafrost, and periglacial erosional processes predominate.

Geology

Most of the hills consist of tightly folded Mesozoic graywacke, argillite, conglomerate, and greenstone flows. There is a central northeast-trending belt of Paleozoic rocks, including steep isolated ridges of limestone. Early Tertiary intrusions with their metamorphic aureoles uphold two small circular groups of high mountains in the southwestern part.

HOLITNA LOWLAND (31)

General topography

The Holitna Lowland is a largely moraine-covered plain 300-800 feet in altitude, crossed by several low, arcuate, hummocky ridges marking the end moraines of glacial advances, and by broad outwash and meander plains along rivers. The Lime Hills, conspicuous isolated steep-sided ridges in the southern part of the lowland, rise to 1,000-2,300 feet.

Drainage

The Holitna Lowland is drained by the Kuskokwim River and its tributaries, the Stony and Swift Rivers, which are glacial streams from the Alaska Range that have braided gravelly courses, and the Holitna River, a clear meandering stream that rises in uplands to the south.

Lakes

There are numerous morainal and thaw lakes throughout the lowland.

Glaciers and permafrost

There are no glaciers. This is probably an area of discontinuous permafrost.

Geology

The bedrock hills are of Mesozoic graywacke, argillite, and conglomerate, and early Paleozoic limestone. Most of the lowland is underlain by moraine and outwash, with thick accumulations of windborne silt.

NUSHAGAK-BRISTOL BAY LOWLAND (32)

General topography

The Nushagak-Bristol Bay Lowland is a moraine- and outwash-mantled lowland with local relief of 50-250 feet, rising from sea level to 300-500 feet at its inner margins. High steep-sided outliers of the Ahklune Mountains rise from the western part. Arcuate belts of morainal topography, 100-300 feet high and 1 to 5 miles wide, enclose large deep glacial lakes on the southeast margin, and cross parts of the lowland west of the Nushagak River.

Drainage

The lowland is drained by the Nushagak and other large rivers that flow into Bristol Bay. Most streams rise in large lakes in ice-carved basins bordering the surrounding mountains and flow into tidal estuaries that appear to be drowned river mouths.

Lakes

The lowland is dotted with morainal and thaw lakes. Large lakes occupy ice-scoured basins along the margins of the lowland. The largest of these, Lake Iliamna, is 80 miles long and 20 miles wide.

Glaciers and permafrost

There are no glaciers in the area, and permafrost is sporadic or absent.

Geology

The lowland is underlain by several hundred feet of outwash and morainal deposits that are mantled, in part, by silt and peat. Outwash deposits are coarse near the mountains and grade to fine sand along the coast. Quaternary deposits thin to a feather edge along the base of surrounding mountains. A small area of low stabilized and active dunes lies east of the Nushagak River.

PROVINCES IN AND BORDERING THE BERING SEA

SEWARD PENINSULA (33)

General topography

The Seward Peninsula contains extensive uplands of broad convex hills and flat divides 500-2,000 feet in altitude, indented by sharply V-shaped valleys (Photo 5); isolated groups of rugged glaciated mountains 20-60 miles long and 10 miles wide with peaks 2,500-4,700 feet in altitude (Map 8); and coastal lowlands and interior basins.

Drainage

Many small rivers, whose lower courses are sluggish and meandering, drain the peninsula. Some of these build deltas into the heads of protected lagoons and bays. The interior lowlands are drained through narrow canyons across intervening uplands.

Lakes

The lowlands have numerous thaw lakes. There are several rock-basin and morainal lakes in the glaciated Bendeleben (32a) and Kigluaik (32b) mountains. Large crater lakes and maars occur in the northern part of the peninsula. Several lakes in the central upland fill depressions between lava flows; some of the depressions were accentuated by faulting and warping.

Glaciers and permafrost

The Seward Peninsula has no glaciers. The entire peninsula is a permafrost region; periglacial processes predominate and ice-wedge polygons are common.

Geology

The bedrock of the peninsula is chiefly Paleozoic biotite schist, gneiss, marble, and metavolcanic rocks, cut by granitoid intrusive masses. Structural trends in the metamorphic rocks are chiefly northerly. The York Mountains (33c) are carved in a mass of resistant marble. (See Map 8.) The Kigluaik, Bendeleben, and Darby Mountains have recent scarplets along their bases and may be Cenozoic uplifts. A Quaternary lava plateau lies in the north-central part. The southern and western mountains are extensively glaciated. Beach placer mines along the south coast disclose tills interbedded with raised and submerged beaches and afford a correlation between marine and glacial chronologies.

YUKON-KUSKOKWIM COASTAL LOWLAND (34)

General topography

The Yukon-Kuskokwim Coastal Lowland is a triangular lake-dotted marshy plain rising from sea level on its western margin to 100-300 feet at its eastern end. Many low hills of basalt surmounted by cinder cones and maar craters and a few craggy mountains of older rocks 2,300-2,450 feet high, rise from the western part of the plain. Low beach ridges, marked by lines of thaw lakes, lie along part of the west coast.

Drainage

The lowland is crossed by meandering streams of extremely low gradient, many of them distributaries or former channels of the Yukon River. These flow to the Bering Sea. The Yukon River flows along the base of hills on the north side of the lowland, and is building a delta into the Bering Sea. The Kuskokwim, on the southeast side, ends in a marine estuary that appears to be a drowned river mouth.

Lakes

The lowland is dotted with innumerable thaw lakes, many of them 10 miles or more long. Some have scalloped shorelines, and probably formed through the coalescence of several smaller lakes. Probably 30-50 percent of the lowland is lake surface.

Glaciers and permafrost

The area contains no glaciers, and is underlain by discontinuous permafrost.

Geology

The lowland is underlain by Quaternary sand and silt to unknown depth. Basalt flows and cinder cones are of Tertiary and Quaternary age. Other bedrock hills consist of Cretaceous sedimentary rocks, cut by early Tertiary intrusions, and of crystalline rocks of unknown age.

BERING PLATFORM (35)

General topography

The Bering Platform is a monotonously smooth submarine plain 100-500 feet deep bordered on the southwest by a submarine scarp several thousand feet deep. A coastal lowland at the head of Norton Sound is included in the platform. Several islands rise abruptly from the plain. Most of the islands are rolling uplands a few hundred to 1,000 feet high bordered by wave-cut cliffs. St. Lawrence Island (35a), the largest, is about 100 miles long and 20 miles wide. It is chiefly a lake-dotted bedrock plain less than 100 feet high above which isolated mountain groups bordered by old sea cliffs rise to altitudes of 1,000-1,500 feet. (See Map 7.) A large shield volcano with many vents is on the north coast of St. Lawrence Island.

Drainage

Many small rivers drain St. Lawrence Island; most small islands have no permanent streams.

Lakes

Thaw lakes abound on the lowlands of St. Lawrence Island; there are small crater lakes in the Pribilof Islands.

Glaciers and permafrost

There are no glaciers. Part of St. Lawrence Island may be underlain by permafrost.

Geology

The Pribilof Islands (35b), St. Matthew Island (35c), Nunivak Island (35d), and north-central St. Lawrence Island are made of Cenozoic basalt flows and pyroclastic debris, with some interbedded sediments. Cinder cones are present on the Pribilofs. St. Lawrence, Diomede, and King Islands are underlain largely by intensely deformed Paleozoic and Mesozoic sedimentary and volcanic rocks and granitoid masses.

AHKLUN MOUNTAINS (36)

General topography

Rugged steep-walled mountains with sharp summits 2,000-5,000 feet high, in groups of ridges separated by broad flat valleys and lowlands, rise abruptly above the lowlands and low hills on the north and east.

Mountains in the southwestern part have rounded summits 1,500-2,500 feet high.

Drainage

The Ahklun Mountains are drained by shallow clear streams that flow directly to Bering Sea on the south and west, to the Nushagak River via the Nuyakuk on the northeast, and to the Kuskokwim River on the northwest. Most rivers are incised in bedrock gorges 20-50 feet deep in the downstream parts of their valleys. Drainage is roughly radial, and several streams in the northwest part flow in canyons directly across structurally controlled ridges.

Lakes

This province is outstanding for the number and beauty of its glacial lakes, which are long narrow bodies of water in U-shaped canyons. The largest, Lake Nerka, is 29 miles long, and at least 40 lakes are more than 2 miles long. Lake depths as great as 900 feet have been reported.

Glaciers and permafrost

A few small cirque glaciers are found in the highest parts of the mountains from Mount Waskey northward. Permafrost occurs sporadically in the region.

Geology

The mountains are made of strongly deformed sedimentary and volcanic rocks of late Paleozoic and Mesozoic age, with some bodies of older schist. These rocks are cut by great northeast-trending faults along which many of the valleys have been eroded. Structural trends control many ridges. Small granitoid masses surrounded by more resistant hornfels have formed many ring-like mountain groups. Late Cenozoic basalts lie on the floor of Togiak Valley. The entire province was intensely glaciated.

ALASKA-ALEUTIAN PROVINCE

The Alaska-Aleutian province consists of an arcuate belt of mountain ranges along the north side of the Pacific Mountain System in Alaska. It is divided into the following sections:

Aleutian Islands (37); Aleutian Range (38); Alaska Range (southern part) (39); Alaska Range (central and eastern parts) (40); Northern Foothills of the Alaska Range (41).

ALEUTIAN ISLANDS (37)

General topography

The Aleutian Islands are a chain of islands surmounting the crest of a submarine ridge 1,400 miles long, 20-60 miles wide, and 12,000 feet high. Fifty-seven volcanoes of Quaternary age, 27 reported active, rise to 2,000-9,000 feet in altitude along the north side of the Aleutian Islands. Other topography in the Aleutian Islands is of two types: (1) wave-cut platforms less than 600 feet high, bordered by low sea cliffs, and (2) intensely glaciated mountainous islands 600-3,000 feet high, indented with fjords, and bordered by cliffs up to 2,000 feet high. (See Map 30.). Broad level intertidal platforms border some islands; they were probably produced by frost-weathering.

Drainage

Streams in the Aleutian Islands are short and swift. Many plunge into the sea by waterfalls. Volcanoes of porous rock have widely spaced ephemeral drainage.

Lakes

Many small lakes occupy irregular ice-carved basins in rolling topography on the glaciated islands. Numerous ponds were formed and enlarged by ice-shove of turf ramparts. A few volcanic craters and calderas are filled by lakes.

Glaciers and permafrost

Firn line is about 3,000 feet east of Unimak Pass and about 4,500 feet west of Unimak Pass. Most high volcanoes bear icecaps or small glaciers, and there are a few cirque glaciers in the mountainous islands. There is probably no permafrost in the Aleutian Islands, but periglacial erosion processes are active because of the cold wet climate.

Geology

The volcanic chain is of constructional origin and late Cenozoic age, and includes many calderas. The remaining non-volcanic islands appear to be emerged parts of fault blocks consisting chiefly of faulted and folded Cenozoic volcanic rocks, locally mildly metamorphosed, with granitoid intrusive rocks on Sedanka, Unalaska, Ilak, and other islands.

ALEUTIAN RANGE (38)

General topography

The Aleutian Range consists of rounded east-trending ridges 1,000-4,000 feet high, surmounted at intervals of 5-85 miles by volcanoes

4,500-8,500 feet high. (See Photo 19.) It merges northward with the Bristol Bay-Nushagak Lowland, and has an abrupt and rugged south coast. The range is extensively glaciated, with U-shaped valleys, cirques, and other features of glacial erosion. Most of the volcanoes reached their final growth after the extensive glaciation of the range.

Drainage

The drainage divide between the Bering Sea and the Pacific Ocean is generally along the highest ridges, within 10 miles of the south coast. Streams to the Pacific are short and steep; those flowing to Bering Sea are longer, and have braided channels.

Lakes

Along the north side of the range are many large lakes, held partly in by end moraines. Most of them extend well below sea level. The largest is Lake Iliamna, 80 miles long and 10-20 miles wide.

Glaciers and permafrost

Firn line is about 3,000-3,500 feet along the axis of the range, and rises northward across the range to 4,000-5,000 feet in the northwestern part. Most volcanoes have glaciers on all sides, and some have summit icefields. There is probably no permafrost, but periglacial erosion processes are active in the cold wet climate.

Geology

Most of the range is composed of mildly deformed folded and faulted Mesozoic and Cenozoic sedimentary rocks, locally intruded by granitoid stocks and surmounted at intervals by volcanic piles of late Tertiary to Recent age. Many volcanoes are calderas. (S e Map 26.) A major fault extends along the north side of the eastern part of the range, separating the sedimentary rocks from a large Mesozoic granitoid batholith on the north.

ALASKA RANGE (Southern Part) (39)

General topography

Between Rainy Pass and Lake Chakachamna the Alaska Range consists of many parallel rugged glaciated north-trending ridges 7,000-12,000 feet high; south of Lake Chakachamna the ridges trend northeast and are 4,000-6,000 feet high. Between the ridges lie broad glaciated valleys with floors less than 3,000 feet high. Local relief is between 4,000 and 9,000 feet. Many spire-like mountains rise in the central part of the range.

Drainage

Large braided glacial streams follow north- and northeast-trending valleys; they flow north or south to the Kuskokwim, southwest to the Nushagak or Kvichak, and east to the Susitna River and Cook Inlet.

Lakes

Many large lakes occupy glaciated valleys within and on the margins of the range; the largest of these is Lake Clark, 49 miles long and 1-4 miles wide.

Glaciers and permafrost

Extensive systems of valley glaciers radiate from the higher mountains. The firn line is lower and glaciers are larger on the southeast side of the range than on the northwest and west sides of the range. The extent of permafrost is unknown.

Geology

Most of the range is underlain by granitoid batholiths of large extent, intrusive into moderately metamorphosed and highly deformed Mesozoic and Paleozoic volcanic and sedimentary rocks, which form scattered areas of lower mountains. Structural trends are generally north, but change abruptly to northeast and east northward across Rainy Pass. Mount Spurr, Mount Iliamna, and Mount Redoubt are large active volcanoes. Well-bedded Jurassic sedimentary rocks form prominent hogbacks and cuestas dipping southward off the south flank of the range toward Cook Inlet.

ALASKA RANGE (Central and Eastern Part) (40)

General topography

The central and eastern part of the Alaska Range consists of two or three parallel rugged glaciated ridges, 6,000-9,000 feet high, surmounted by groups of extremely rugged snowcapped mountains more than 9,500 feet high. (See Photo 12.) The Mentasta-Nutzotin Mountain segment (40a) at the eastern end of the Alaska Range has a single axial ridge. The ridges are broken at intervals of 10-50 miles by cross-drainage or low passes; much of the drainage appears superimposed. (See Photo 13 and Map 20.) The range rises abruptly from lower country on either side, and its longitudinal profile, seen from a distance, is irregular. Mount McKinley, 20,269 feet high, is the highest mountain in North America. (See Photo 13.)

Drainage

The central and eastern part of the Alaska Range is crossed at intervals of 25-100 miles by north-flowing tributaries of the Tanana and Yukon Rivers. Most of the range drains to the Tanana. The west part drains to the Kuskokwim and parts of the south flank to the Susitna and Copper Rivers. Streams are swift and braided, and most rivers head in glaciers.

Lakes

There are a few rock-basin lakes and many small ponds in areas of ground moraine. Lakes are rare for a glaciated area.

Glaciers and permafrost

The firn line on the south side of the range is 5,000-7,000 feet in altitude and on the north side of the range is 6,000-8,000 feet in altitude, reflecting the northward decrease in cloudiness and precipitation as one passes from the Gulf of Alaska coast to the interior. The high mountains are sheathed in ice, and valley glaciers as much as 40 miles long and 5 miles wide radiate from them. With some glaciers (e. g., Black Rapids Glacier, Muldrow Glacier), short periods of rapid advance have alternated with long periods of stagnation. Short valley glaciers lie in north-facing valleys in the lower parts of the range. Rock glaciers are common. Permafrost is extensive and solifluction features are well developed.

Geology

The internal structure of the Alaska Range is a complex synclinorium with Cretaceous rocks in the center and Paleozoic and Precambrian rocks on the flanks. This synclinorium is cut by great longitudinal faults that are marked by lines of valleys and low passes. The synclinorium was probably formed near the close of the Mesozoic era. Many roughly oval granitoid stocks and batholiths support groups of high mountains that have cliffs as much as 5,000 feet high. (See Photo 12.)

Synclinal areas of Tertiary rocks underlie longitudinal lowlands. Much of the gross topography of the range is believed to be produced from structures of a mid-Tertiary orogeny by removal of easily eroded Tertiary rocks to form lowlands. Recent scarplets as much as 30 feet high can be seen on several longitudinal faults.

NORTHERN FOOTHILLS OF THE ALASKA RANGE (41)

General topography

The northern foothills of the Alaska Range are flat-topped east-trending ridges 2,000-4,500 feet in altitude, 3-7 miles wide and 5-20 miles long, that are separated by rolling lowlands 700-1,500 feet high and 2-10 miles wide. The foothills are largely unglaciated, but some valleys were widened during the Pleistocene epoch by glaciers from the Alaska Range. Colorful badlands abound in areas of rapid erosion in soft Tertiary rocks.

Drainage

The major streams of the foothills are superimposed across the topography. Most streams are nearly parallel, rise for the most part in the Alaska Range, and flow north to N. 20° W. across the ridges in rugged impassable V-shaped canyons and across the lowlands in broad terraced valleys. The entire section drains to the Tanana.

Lakes

A few small lakes of thaw origin lie in the lowland passes, and morainal areas have shallow irregular ponds.

Glaciers and permafrost

The entire area is below the firn line and there are no local glaciers, although a few glaciers from the Alaska Range terminate in the foothills. Permafrost is extensive, and polygonal ground and solifluction features are well developed.

Geology

Crystalline schist and granitoid intrusive rocks make up most of the ridges, which are anticlinal. Poorly consolidated Tertiary rocks underlie the lowlands; thick coarse conglomerate near the top of the Tertiary section forms cuestas and ridges where it dips 20°-60°, and broad dissected plateaus where it is flat-lying. The topography reflects closely the structure of monoclines and short broad flat-topped anticlines with steep north flanks. Flights of tilted terraces on north-flowing streams indicate Quaternary tilting and uplift of the Alaska Range. The Tertiary rocks contain thick beds of subbituminous coal.

COASTAL TROUGH PROVINCE

The Coastal Trough Province is a belt of lowlands extending the length of the Pacific Mountain System, interrupted at intervals by oval mountain groups. It is divided into the following sections:

Cook Inlet-Susitna Lowland (42); Broad Pass Depression (43); Talkeetna Mountains (44); Upper Matanuska Valley (45); Clearwater Mountains (46); Gulkana Upland (47); Copper River Lowland (48); Wrangell Mountains (49); Duke Depression (Not described - mostly in Yukon Territory) (50); Chatham Trough (51); Kupreanof Lowland (52).

COOK INLET-SUSITNA LOWLAND (42)

General topography

The Cook Inlet-Susitna Lowland is the major population center of Alaska, and contains most of the developed agricultural land. Most of the lowland is less than 500 feet above sea level and has a local relief of 50-250 feet. (See Photos 16 and 20.) It is a glaciated lowland with areas of ground moraine and stagnant ice topography, drumlin fields, eskers, and outwash plains. Rolling upland areas near the bordering mountain ranges rise to about 3,000 feet, and isolated mountains as much as 4,800 feet high rise from the central part of the lowland.

Drainage

The lowland is drained by the Susitna River and other streams that flow into Cook Inlet. Most of these streams head in glaciers in the surrounding mountains. The shores of Cook Inlet are for the most part gently curving steep bluffs 50-250 feet high.

Lakes

Three large lakes fill ice-carved basins at the margins of surrounding mountains. The largest, Lake Tustumena, is 23 miles long and 7 miles wide. Hundreds of small irregular lakes and ponds occur in areas of stagnant ice topography and on ground moraines. Strängemoore ponds are common in marshes.

Glaciers and permafrost

The area is almost ice-free, although one glacier reaches the lowland from the Alaska Range on the west, and sporadic permafrost is present in the north part.

Geology

Bedrock beneath the lowland consists mainly of poorly consolidated coal-bearing rocks of Tertiary age, generally mildly deformed or flat lying; this rock is mantled by glacial moraine and outwash, marine and lake deposits. Sequences of moraines record successive glacial advances. The boundaries of the lowland are of two kinds: (1) abrupt straight mountain fronts which are probably faultline scarps, and (2) uplands of hard pre-Tertiary rocks that slope gently toward the lowland. The latter are probably exhumed parts of the surface on which the Tertiary rocks were deposited; the edge of the lowland generally marks the edge of the Tertiary cover, which dips gently away from the mountains. The isolated mountains in the center of the lowland generally consist of metamorphic and granitoid rocks of Mesozoic age.

BROAD PASS DEPRESSION (43)

General topography

The Broad Pass Depression is a trough with a glaciated floor, 1,000-2,500 feet high and 5 miles wide, that opens on the east to a broad glaciated lowland with rolling morainal topography and central outwash flats. The bounding mountain walls of the trough are several thousand feet high. Long narrow drumlin-like hills on the floor of the trough trend parallel to its axis, and the main streams in the trough are incised in rock-walled gorges a few hundred feet deep. The trough opens on its south end to the Cook Inlet-Susitna Lowland.

Drainage

The divide between the Bering Sea and Pacific Ocean drainages crosses this depression in two places and is marked by nearly imperceptible passes. The southwest part drains by the Chulitna River to the Susitna; the central part drains by the Nenana River north to the Yukon; and the eastern part is drained by the headwaters of the Susitna. Most streams head in glaciers in the surrounding mountains, and are swift, turbid, and braided.

Lakes

Many long narrow lakes lie in morainal depressions in the central part of the trough. Morainal and thaw ponds are common in the eastern part.

Glaciers and permafrost

There are no glaciers. Most of the depression is underlain by permafrost.

Geology

Patches of poorly consolidated Tertiary coal-bearing rocks, in fault contact with older rocks of the surrounding mountains, show that this depression is a graben of Tertiary age. Most of the bedrock consists of highly deformed slightly metamorphosed Paleozoic and Mesozoic rocks that are also exposed in the surrounding mountains. Ground moraine mantles the lowland.

TALKEETNA MOUNTAINS (44)

General topography

The Talkeetna Mountains are an oval highland area of diversified topography that interrupts the belt of lowlands that makes up the Coastal Trough province. The central Talkeetna Mountains (44c) is a compact group of extremely rugged radial arete ridges 6,000-8,800 feet in altitude, with few low passes, that isolate steep-walled U-shaped valleys. Accordant flat ridge-crests in the western and eastern parts of the central Talkeetna Mountains suggest a warped peneplain that plunges beneath Tertiary rocks in adjacent lowlands. (See Photo 16.). The glaciated Chulitna Mountains (44a), a compact group of mountain blocks separated by low passes, are isolated from the central Talkeetna Mountains by the Fog Lakes Upland (44b), a northeast-trending region of broad rolling summits, 3,000-4,500 feet high, which has a glacially sculptured mammilated surface in its southwestern part but is unglaciated in the northeast. A similar upland (the Clarence Lake Upland, 44d) borders the mountains on the east.

Drainage

The central Talkeetna Mountains has a radial drainage of large braided glacial streams that are tributary to the Susitna, Matanuska, and Copper Rivers. The extreme north drains to the Yukon via the Nenana River. The Susitna River flows west across the Talkeetna Mountains in a narrow steep-walled gorge that in places is over 1,000 feet deep. West-flowing streams in the southwestern Talkeetna Mountains have many long south tributaries and few or no north tributaries; an insolation effect, favoring the growth of glaciers in north-facing valley heads and inhibiting their growth on south-facing slopes, probably caused this asymmetry.

Lakes

There are few lakes in the southern part of the Talkeetna Mountains. Many lakes, some 5 miles long, occupy ice-scoured and moraine-dammed basins in the northern part.

Glaciers and permafrost

The firn line is between 6,500 and 7,000 feet. Glaciers 5-15 miles long lie at the heads of most valleys in the central Talkeetna Mountains. A few cirque-glaciers occupy north-facing valley heads in the northeastern Talkeetna Mountains and the Chulitna Mountains. Rock glaciers are common in the southeastern Talkeetna Mountains and in the Chulitna Mountains. Permafrost probably underlies most of the area; altiplanation terraces are present in unglaciated parts of the northeastern Talkeetna Mountains.

Geology

A large mid-Jurassic batholith in the central and western Talkeetna Mountains intrudes Jurassic volcanic rocks and older rocks and is eroded into cliffs and spires. The southeastern Talkeetna foothills (44e) are composed of soft sandstone and shale of Jurassic and Cretaceous age, capped by flat-lying cliff-forming Tertiary basalt flows aggregating several thousand feet in thickness. The northern part of the Talkeetna Mountains consists of Paleozoic and Mesozoic greenstone, graywacke, and argillite in northeast-trending belts; greenstone forms mountainous tracts.

UPPER MATANUSKA VALLEY (45)

General topography

The Upper Matanuska Valley is a glaciated trough 2-5 miles wide with longitudinal bedrock hills 500-1,000 feet high and steep bounding walls several thousand feet high. Altitude of its floor ranges from 800 feet on the west to 2,000 feet on the east.

Drainage

The Upper Matanuska Valley is drained entirely by the Matanuska River, which flows the length of the trough.

Lakes

Many small narrow lakes occupy ice-carved bedrock basins, and ponds are common in morainal areas.

Glaciers and permafrost

The terminus of the Matanuska Glacier reaches the east end of the trough. Permafrost is present in the eastern part of the trough, but its extent is unknown.

Bedrock geology

The Upper Matanuska Valley is a structurally controlled trough bounded on the north by a major fault (the Castle Mountain fault) and on the south by a steep unconformity and faults. It is underlain by easily eroded rocks of Cretaceous and Tertiary age, which are highly deformed and were intruded by gabbro sills and stocks. It contains several coal fields. The bordering mountains are of older and more resistant rocks.

CLEARWATER MOUNTAINS (46)

General topography

The Clearwater Mountains consist of two or three steep rugged east-trending ridges rising to altitudes of 5,500-6,500 feet, separated by U-shaped valleys 3,000-3,500 feet high. They are intensely glaciated. The ridges are asymmetrical; long spurs on their north sides separate large compound cirques; their south sides are relatively smooth mountain walls grooved by short steep canyons.

Drainage

The entire section is tributary to the Susitna River.

Lakes

There are a few rock-basin lakes in cirques and passes. The largest lake is less than 1 mile long.

Glaciers

The north slopes of the highest peaks have a few cirque-glaciers.

Geology

The Clearwater Mountains are underlain chiefly by Permo-Triassic greenstone and Mesozoic argillite and graywacke. The rocks are highly deformed, strike generally east, and dip steeply.

GULKANA UPLAND (47)

General topography

The Gulkana Upland consists of rounded east-trending ridges separated by lowlands 2-10 miles wide. The ridge crests, 3,500-5,500 feet in altitude, are 4-15 miles apart and are cut at 5-15 mile intervals by notches and gaps that were eroded by glaciers or glacial meltwater. (See Map 21.) The lowlands are floored by glacial deposits showing morainal and stagnant ice topography, with large esker systems. (See Map 22).

Drainage

The southeastern and eastern part drains south to the Copper River; the western part drains southwest to the Susitna River; and the north-central part drains north via the Delta River to the Tanana and Yukon. The drainage divide between the Pacific Ocean and Bering Sea has an irregular course along this province and is in part along eskers. (See Map 22.)

Lakes

Many long narrow lakes occupy rock-cut basins in notches through the ridges. Irregular lakes abound in some areas of morainal topography.

Glaciers and permafrost

A few cirque glaciers lie on the north sides of the highest ridges. The termini of a few glaciers from the Alaska Range are in this section. The upland is underlain by permafrost, and contains ice-wedges, pingoes, and altiplanation terraces.

Geology

Bedrock is chiefly greenstone of late Paleozoic and Mesozoic age; structures trend easterly. Areas of relatively low relief in the northern part are underlain by poorly consolidated Tertiary sedimentary rocks.

COPPER RIVER LOWLAND (48)

General topography

The eastern part of the Copper River Lowland (48a) is a relatively smooth plain 1,000-2,000 feet high trenched by the valleys of the Copper River and its tributaries, which have steep walls 100-500 feet deep. (See Photo 14.) The Copper and Chitina valleys, eastward prongs of this plain, contain longitudinal morainal and ice-scoured bedrock ridges that rise above axial outwash plains. The western part of the Copper River Lowland, the Lake Louise Plateau (48b), is a rolling upland, 2,200-3,500 feet in altitude, with morainal and stagnant ice topography; the broad valley of the Nelchina and Tazlina Rivers separates this upland from the Chugach Mountain.

Drainage

The eastern and southern parts of the Copper River Lowland are drained by the Copper River and its tributaries. The northwestern part is drained by the Susitna River. Low passes lead to the heads of the Delta, Tok, and Matanuska Rivers. Most rivers head in glaciers in surrounding mountains and have braided upper courses. Salty ground water has formed salt springs and mud volcanoes.

Lakes

Large lakes occupy deep basins at the mountain fronts. Thaw lakes are abundant in the eastern plain. Lakes occupy abandoned meltwater channels, and lakes in morainal depressions in the western upland are as much as 6 miles across. Lakes more than 2 miles wide are bordered by beaches and wave-cut cliffs, whereas irregular muskeg marshes encroach on smaller lakes.

Glaciers

There are no glaciers. The entire lowland is a region of permafrost. The permafrost table is within 5 feet of the surface and permafrost is at least 100 feet thick.

Geology

Bedrock beneath the southern part of the lowland is chiefly easily eroded sandstone and shale of Mesozoic age; bedrock beneath the northern part is chiefly resistant late Paleozoic and Mesozoic metavolcanic rocks. Tertiary gravels cap some hills. Ground and end moraine and stagnant ice deposits mantle much of the lowland. The eastern plain is underlain by glacio-lacustrine and glacio-fluvial deposits at least 500 feet thick.

WRANGELL MOUNTAINS (49)

General topography

The Wrangell Mountains are an oval group of great shield and composite volcanoes (Mount Wrangell, 14,005 feet high, is still active), that rises above a low plain on the north and west and above heavily glaciated cliffed and castellated ridges on the south and east. (See Photo 14.) Six volcanoes higher than 12,000 feet, the highest of which is Mount Blackburn, 16,523 feet high, make up the greater part of the mountains.

Drainage

Seventy-five percent of the area drains to the Copper River, which encircles the mountains on the west. The remainder drains to the Tanana via the Nabesna and Chisana Rivers, and to the Yukon via the White River.

Lakes

There are a few rock-basin lakes in the extreme north. Several ice-marginal lakes lie in Skolai Pass at the east end of the mountains.

Glaciers and permafrost

Firn line is about 7,000 feet. A large icecap covers most of the high mountains, and feeds large valley glaciers. Rock glaciers are common in the southeastern Wrangell Mountains. Permafrost is probably present in the glacier-free areas, but its extent is unknown.

Geology

The Wrangell Mountains are a great pile of Cenozoic volcanic rocks that rests on a deformed sequence of Paleozoic and Mesozoic sedimentary and volcanic rocks, among which are cliff-forming units of limestone and greenstone. Some granitoid masses intrude the Mesozoic rocks. An important copper belt, including the Kennicott Mine, lies on the south side of the Wrangell Mountains.

CHATHAM TROUGH (51)

General topography

The Chatham Trough is a deep straight trench, 4-15 miles wide, which is entirely submerged except at its north end. Its average depth is more than 1,900 feet, and its maximum depth is 2,900 feet. Mountains on either side rise to 2,500-5,000 feet.

Geology

The Chatham Trough probably marks a major faultline. Structures on opposite sides of the trough do not match across the trough.

KUPREANOF LOWLAND (52)

General topography

The Kupreanof Lowland is a region of islands and channels. Islands of rolling heavily glaciated terrain with a local relief of 300-500 feet and a maximum relief of 1,000-1,500 feet are separated by an intricate network of waterways. (See northeast part of Map 31.) Scattered blocklike mountains with rounded hummocky summits 2,000-3,000 feet in altitude rise above the general level of the lowland. Parts of some islands are plains a few feet above sea level cut across rocks of varying hardness.

Drainage

The islands of the lowland are drained by many short clear streams that generally follow linear depressions etched by the Pleistocene ice sheets along joints, faults, bedding, and schistosity.

Lakes

There are abundant lakes in glacially scoured basins. Parts of some islands are almost 50 percent lake surface.

Glaciers and permafrost

There are no glaciers or permafrost.

Geology

The lowland is underlain mainly by well-consolidated faulted and folded Paleozoic and Mesozoic sedimentary rocks, locally metamorphosed. Small elliptical granitoid and ultramafic masses underlie most of the high mountains. The northern part of the lowland has an extensive Cenozoic basalt field. Small patches of Tertiary sedimentary rocks have been found.

PACIFIC BORDER RANGES PROVINCE

The Pacific Border Ranges province consists of several mountain ranges bordering the Pacific Coast, and the coastal shelf. It is divided into the following sections:

Kodiak Mountains (53); Kenai-Chugach Mountains (54); Saint Elias Mountains (55); Fairweather Range (55a); Gulf of Alaska coastal section (56); Chilkat-Baranof Mountains (57); Prince of Wales Mountains (58).

KODIAK MOUNTAINS (53)

General topography

The Kodiak Mountains include a group of mountainous islands that are the structural continuation of the Kenai-Chugach Mountains (54) but whose topography is more finely textured and on a smaller scale than that of the Kenai-Chugach Mountains. The Kodiak Mountains are mostly glaciated, but the glaciation of western Kodiak Island was very early. Summit altitudes are between 2,000 and 4,000 feet. Kodiak Island has a rugged northeast-trending divide with horns and aretes from which broad smooth ridges extend northwesterly. The topography southeast of the divide has a strong northeasterly grain normal to the drainage. (See Map 28.) The coastline is extremely irregular, with many fjords and islands. The northern part of Afognak Island is a hilly lowland, and the western part of Kodiak Island has many broad valleys.

Drainage

The islands of the Kodiak Mountains are drained mostly by swift clear streams that are less than 10 miles long. Two rivers, each about 25 miles long, drain much of southwestern Kodiak Island.

Lakes

There are several lakes more than a mile long in the southwestern part of Kodiak Island and on Afognak Island. Small ponds are scattered over the glacially sculptured topography. The glaciated valleys heading in the main divide have lines of paternoster lakes.

Glaciers and permafrost

The firn line is between 3,000 and 3,500 feet along the main divide of Kodiak Island, which has 40 cirque glaciers, all less than 2 miles long; the firn line rises to much more than 4,000 feet in the northwestern part of Kodiak Island. Permafrost is probably absent.

Geology

The Kodiak Mountains are underlain mostly by Mesozoic argillite and graywacke. Older rocks, chiefly greenstone and schist, lie along the northwest coast. The main divide of Kodiak Island is underlain by a granitoid batholith. Northeast-trending belts of down-faulted easily eroded Tertiary rocks lie on the southeast side of Kodiak Island and make up the Trinity Islands. Lateral moraines, ice-marginal drainage channels through the ends of ridges, and old greatly modified cirques half buried in alluvium (Map 26) indicate that western Kodiak Island was not covered by ice of the last glaciation, and that ice from the Aleutian Mountains banked against its western shore.

KENAI-CHUGACH MOUNTAINS (54)

General topography

The Kenai-Chugach Mountains form a rugged barrier along the north coast of the Gulf of Alaska. High segments of the mountains are dominated by extremely rugged east-trending ridges 7,000-13,000 feet high. Low segments consist of discrete massive mountains 5-10 miles on a side and 3,000-6,000 feet high, separated by a reticulate system of through valleys and passes 1/2 to 1 mile wide that are eroded along jointing and cleavage. (See Map 24.) The entire range has been heavily glaciated and the topography is characterized by horns, aretes, cirques, U-shaped valleys and passes, rock-basin lakes, and grooved and mammilated topography. The south coast is deeply indented by fjords and sounds, and ridges extend southward as chains of islands (Map 29). The north front is an abrupt mountain wall.

Drainage

The drainage divide, generally an ice divide, is along the highest ridges, and is commonly only a few miles from the Pacific Ocean. Streams are short and swift; most head in glaciers. The Copper River crosses the eastern part of the Chugach Range in a canyon 6,000-7,000 feet deep.

Lakes

Large lakes fill many ice-carved basins along the northern margin of the Chugach Mountains and throughout the northern Kenai Mountains. Lake George is an ice-margin lake dammed by the Knik Glacier, and discharges by an annual flood.

Glaciers and permafrost

The firn line rises from 2,500-3,500 feet on the south side of the mountains to 7,000-8,000 feet on the north side of the central Chugach Mountains. All higher parts of the range are buried in great icefields, from which valley and piedmont glaciers radiate. Many glaciers on the south side of the mountains are tidal. The extent of permafrost is unknown.

Geology

The Kenai-Chugach Mountains are composed chiefly of dark gray argillite and graywacke of Mesozoic age, mildly metamorphosed and with a pronounced vertical cleavage that strikes parallel to the trend of the range. In the Prince William Sound area large bodies of greenstone are associated with the argillite and graywacke. A belt of Mesozoic and Paleozoic schist, greenstone, chert, and limestone lies along the north edge of the Kenai and Chugach Mountains. All these rocks are cut by granitoid masses.

SAINT ELIAS MOUNTAINS (55)

General topography

The Saint Elias Mountains are probably the most spectacular mountains of North America. Massive isolated blocklike mountains 14,000-19,000 feet high rise at intervals of 5-30 miles from a myriad of narrow ridges and sharp peaks 8,000-10,000 feet high that give the impression, seen from a distance, of a broad ice dome. The average height of icefields in the interconnected valley system is 3,000-7,000 feet. Local relief is extreme and jagged cliffs abound. (See Photo 15.)

Drainage

Drainage is almost entirely by glaciers. The ice divides between the Yukon, Copper, Alsek, and Pacific Ocean drainages meet in this range. The Alsek River flows west to the Pacific across this range from lowlands on the northeast side, and separates the Fairweather Range subsection from the rest of the mountains.

Lakes

There are no lakes.

Glaciers and permafrost

All parts of the range gentle enough to hold snow are sheathed in glacial ice. A continuous network of icefields and glaciers 3-15 miles wide and as much as 80 miles long penetrates the range and feeds piedmont glaciers to the south. The extent of permafrost is unknown.

Geology

The high mountains are probably underlain by crystalline schist and granitoid intrusive masses. A belt of Permian and Triassic volcanic and sedimentary rocks extends along the north side of the range. Lower Cretaceous sedimentary rocks lie in down-faulted basins in the center of the range and probably underlie ice-filled valleys. The entire sequence is thrust southward against Cretaceous and Cenozoic rocks; thrusting may be active today. Cenozoic volcanoes are present in the north part of the range; some of these may still be active.

FAIRWEATHER RANGE (55a)

(Subsection of the St. Elias Range)

<u>General topography</u>

The Fairweather Range is an exceedingly steep and high unbroken barrier between the Pacific Ocean and Glacier Bay, with mountains 12,000-15,000 feet high only 15 miles from tidewater. (See Photo 17.) Peaks are high ice-clad pyramids with steep cliffed walls, sharp ridges, and spire-like summits. There are a few subsummit ice plateaus, but no passes across the range.

<u>Drainage</u>

The Fairweather Range is drained entirely by glaciers; most of these discharge into the Pacific Ocean or Glacier Bay.

<u>Lakes</u>

There are no lakes.

<u>Glaciers and permafrost</u>

Most of the range is above firn line (4,000 feet) and supports vigorous glaciers that descend to tidewater. Glaciers on the west side are stable; those on the east side have retreated, exposing in the last 60 years fjords with walls nearly 6,000 feet high. Permafrost is probably absent.

<u>Geology</u>

The Fairweather Range is underlain mainly by crystalline schist that has northwesterly structural trends parallel to the length of the range. Many large granitoid stocks, and three large elliptical layered mafic bodies, have intruded the schist. The range is bounded on its southwest side by a major fault on which a lateral displacement of 21 feet took place in July 1958.

GULF OF ALASKA COASTAL SECTION (56)

General topography

The Gulf of Alaska coastal section is an area of diversified topography carved in Tertiary rocks. A coastal plain marked by longitudinal beach and dune ridges, crossed in places by outwash plains and by belts of morainal topography, is backed by marine terraces up to 800 feet high and by rugged intricately gullied mountain ridges up to 12,000 feet high. The straight exposed coastline is broken at intervals of 50-100 miles by large fjords. (See Photo 21.)

Drainage

Short meltwater streams of large volume cross the lowland. Bars built by coastal currents cause the river mouths to go through cycles of westward migration followed by breakthrough during periods of high runoff.

Lakes

There are many ephemeral lakes along the margins of the piedmont glaciers. A few large lakes occupy ice-carved basins.

Glaciers and permafrost

The firn line is 2,000-4,000 feet. Icefields on higher mountains and valley glaciers in most valleys coming from the St. Elias and Chugach Mountains feed enormous piedmont glaciers, of which Malaspina Glacier is the largest. (See Photo 15.) Glacial advances within the last thousand years are greater than any advance recorded in the Pleistocene. Permafrost is absent.

Geology

The Cenozoic rocks are intensely deformed yet easily eroded claystone, sandstone, and conglomeratic sandy mudstone, tightly folded and thrust to the south. Large thrust faults separate this section from mountains to the north and northeast. Marine terraces show that the area has been uplifted rapidly.

CHILKAT-BARANOF MOUNTAINS (57)

General topography

The Chilkat-Baranof Mountains are a highland area of diversified topography, which is divided into four subsections: The Alsek Ranges (57a), a region of rugged glaciated mountains 4,000-7,500 feet high, with horns and aretes (Photo 17.); The Glacier Bay subsection (57b), a lowland, largely drowned, with isolated mounded mountains; the Chichagof Highland (57c), mainly northwest-trending ridges with accordant rounded summits 3,000-3,500 feet high and long fjords and through valleys; and the Baranof Mountains, (57d), a rugged assymetric chain 3,000-5,300 feet high, with a steep eastern slope (Map 27) and a more gentle southwest slope deeply indented by fjords. The southern two-thirds of the Chilkat-Baranof Mountains consists of islands. A narrow strandflat lies on the west coast of Chichagof and Baranof Islands.

Drainage

The Chilkat-Baranof Mountains are drained by short swift streams that flow directly to the ocean. Chains of cascades are common on the east side of Baranof Island. (See Map 27.)

Lakes

Lakes abound in ice-carved basins in Baranof and southwestern Chichagof Islands. (See Map 27.) Elsewhere lakes are rare.

Glaciers and permafrost

The Alsek Ranges have large icefields with tidal glaciers; Glacier Bay was filled with ice at least 2,000 feet thick as late as 1750, and glaciers have retreated more than 50 miles since then. Mountains on Baranof Island higher than 4,500 feet support cirque glaciers and small icefields. (See Map 27.) Permafrost is probably absent.

Geology

Northwest-trending belts of Paleozoic and Mesozoic sedimentary and volcanic rocks underlie the Alsek Ranges and Glacier Bay subprovinces; northwest-trending belts of crystalline schist and gneiss, with large areas of migmatitic and granitoid rocks underlie the Chichagof Highland and the northeastern part of the Baranof Mountains, and are bordered on the west by a belt of Mesozoic graywacke and greenstone. The rocks are cut by many northwest-trending faults. Quaternary volcanoes make up southern Kruzof Island.

PRINCE OF WALES MOUNTAINS (58)

General topography

The Prince of Wales Mountains are moderately rugged mountains with rounded hummocky summits 2,000-3,500 feet high and some spire-like aretes up to 3,800 feet in altitude. They are dissected by steep-walled U-shaped valleys and by fjords 600-1,000 feet deep. (See Map 31.)

Several passes less than 500 feet high cross the range. The northeastern front is abrupt, and the northwest boundary is indistinct. Karst topography is found in areas of marble on Dall and Long Islands, in the southwest Prince of Wales Mountains.

Drainage

Short swift streams, with many lakes and waterfalls, drain the mountains, and generally follow trenches eroded by Pleistocene glaciers along joints, faults, and bedding.

Lakes

There are many rock-basin and cirque lakes, a few as much as 2,000 feet above sea level. The largest lake is 7 miles long and 1 mile wide.

Glaciers and permafrost

One or two very small glaciers lie on the protected north sides of the highest peaks. There is no permafrost.

Geology

The Prince of Wales Mountains are underlain in part by well consolidated slightly metamorphosed Paleozoic sedimentary and volcanic rocks and in part by crystalline schist and marble. Several small granitoid stocks cut these rocks.

COAST MOUNTAINS

The Coast Mountains form a massive mountain barrier underlain by the Coast Range Batholith. It can be divided into the Boundary Ranges (59) and the Coastal foothills (60).

BOUNDARY RANGES (59)

General topography

The Boundary Ranges are a glacier-covered upland 5,000-7,000 feet high dissected by a dendritic pattern of deep steep-walled U-shaped valleys. The ridges have rounded accordant summits, and are surmounted by aretes and horns rising to 8,000-10,000 feet. Many of the valleys are drowned to form fjords. Passes are rare, and valley heads are isolated. The mountains give an impression of great bulk, with cliffs that plunge several thousand feet to tidewater. (See Map 23 and Photo 18.)

Drainage

The summit of the Coast Mountains coincides approximately with the International Boundary; most of the range in Alaska is drained by glacial streams less than 20 miles long. Large braided rivers flow southwestward across the range at intervals of 30-120 miles from low-lying areas in northwestern British Columbia.

Lakes

A few small lakes lie in rock basins on valley floors and in mountainside hollows in the western glacier-free part of the range.

Glaciers and permafrost

Firn line is about 4,500-5,000 feet. Extensive mountain icecaps, the largest 90 miles long, feed many valley glaciers, some of which descend to tidewater. Extent of permafrost is unknown.

Geology

The Boundary Ranges are underlain mostly by the massive granitoid rocks of the Coast Range batholith; a belt of schist and phyllite along its western margin and migmatized roof pendants within the batholith give a strong northwesterly grain to the topography.

COASTAL FOOTHILLS (60)

General topography

The coastal foothills include closely spaced mountainous islands and peninsulas 1,000-4,500 feet high, and consist of blocks of high mountains 3-30 miles on a side separated by flat-floored valleys and straits 1/2 mile to 10 miles wide. Mountains less than 3,500 feet high are glacially overridden and have rounded hummocky summits. (See Photo 22.) Higher mountains are generally sharp crested. The boundaries with bordering provinces are indistinct.

Drainage

Few streams are more than 10 miles long. The lower parts of most valleys are drowned, forming inlets and harbors.

Lakes

There are many rock-basin lakes, the largest 8 miles long and 1 mile wide.

Glaciers and permafrost

The coastal foothills are almost entirely ice-free. A few small glaciers lie on the north sides of high peaks on Admiralty Island. There is no permafrost.

Geology

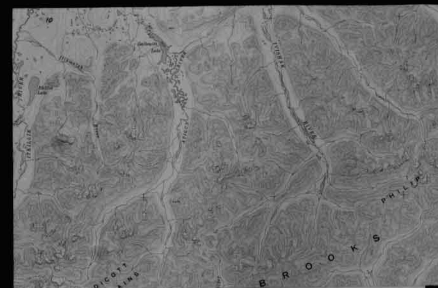
Northwest-trending belts of metamorphic rocks, cut by many strike faults, give the topography a pronounced northwest grain. Small granitoid and ultramafic bodies, and westerly projections of the Coast Range batholith cut the metamorphic rocks. Southwest Admiralty Island is a high Tertiary basalt plateau.


UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
ALASKA
COMPILED FROM ALL AUTHENTIC SOURCES, CHIEFLY MAPS OF THE GEOLOGICAL SURVEY AND ARMY AIR FORCES.
SCALE 1:2,500,000
1 INCH=APPROXIMATELY 40 MILES
ALASKA MAP E
EDITION OF 1946 REPRINTED 1952
EXPLANATION
Extremely high rugged mountains
(Summits more than 10,000 feet high)
Moderately high rugged mountains
(Summits 5,000-10,000 feet high)
Low mountains, generally rolling
(Summits 1,000-5,000 feet high)
Plateaus and highlands of rolling topography and gentle slopes
(Summits 1,000-3,000 feet high)
Plains and lowlands
(Flat areas, generally less than 1,000 feet high)
Boundary between major physiographic divisions
Boundary between physiographic provinces
Boundary between physiographic sections
Boundary between subdivisions named in the accompanying text
Boundary between areas of differing topography within a section, not named in the accompanying text
Dune fields
Active volcanoes
Inactive volcanoes
Calderas
Gorge from one lowland to another across mountains (generally across structure)
(Areas of intermediate topography have diagonal color bands)
PHYSIOGRAPHIC DIVISIONS OF ALASKA
COMPILED BY CLYDE WAHRHAFTIG
WITH THE ADVICE AND ASSISTANCE OF ROBERT S. BICKEL, WILLIAM P. BROSGÉ, ROBERT L. DETTERMAN, ARTHUR GRANTZ, J. M. HOARE, DAVID M. HOPKINS, E. H. LATHRAM, MARVIN D. MANGUS, DON J. MILLER, WILLIAM W. PATTON, C. L. SAINSBURY, I. L. TAILLEUR, AND JOHN R. WILLIAMS.
FROM SELECTED AERIAL PHOTOGRAPHS AND ALL TOPOGRAPHIC MAPS AVAILABLE ON OCTOBER 1, 1959, AND FROM PUBLISHED AND UNPUBLISHED DESCRIPTIONS OF TOPOGRAPHY AND GEOLOGY.
MAJOR NORTH AMERICAN PHYSIOGRAPHIC DIVISIONS IN ALASKA
Interior Plains
Rocky Mountain System
Intermontane Plateaus
Pacific Mountain System
ARCTIC COASTAL PLAIN (1)
ARCTIC FOOTHILLS (2)
Central and Eastern Brooks Range (6)
DeLong Mts. (3)
Baird Mountains (5)
SEWARD PENINSULA (33)
Bering Platform (35)
Nulato Hills (25)
Yukon-Kuskokwim Coastal Lowland (34)
AHKLUN MOUNTAINS (36)
Nushagak-Bristol Bay Lowland (32)
Aleutian Range (38)
Kodiak Mountains (38)
Alaska Range (Southern Part) (39)
Cook Inlet-Susitna Lowland (42)
Kenai-Chugach Mountains (54)
Upper Matanuska Valley (45)
Gulf of Alaska Coastal Section (56)
St. Elias Mountains (55)
Wrangell Mts. (49)
Yukon Flats Section (13)
Rampart Trough (14)
Old Crow Plain (8)
Broad Pass Depression (43)
Clearwater Mts. (46)
Northway-Tanacross Lowland (12)
Duke Depression (50)
Chatham Trough (51)
Prince of Wales Mountains (58)
ALEUTIAN ISLANDS (37)
FOX ISLANDS
ANDREANOF ISLANDS
PRIBILOF ISLANDS

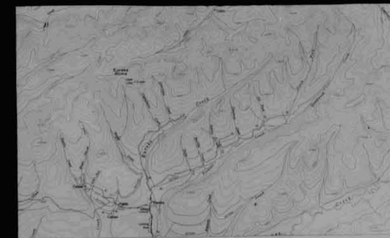
MAP 7. EAST END OF ST. LAWRENCE ISLAND ON THE BERING SHELF. A HILLY UPLAND BORDERED BY WAVE-CUT CLIFFS AND SURROUNDED BY A RAISED MARINE PLATFORM 1-2 MILES WIDE. SCALE 1:250,000. CONTOUR INTERVAL 100 FEET. ST. LAWRENCE ISLAND QUADRANGLE.

MAP 8. THE YORK MOUNTAINS, WEST END OF SEWARD PENINSULA, A SMALL GROUP OF RUGGED MOUNTAINS UNDERLAIN BY CRYSTALLINE LIMESTONE. A MARINE TERRACE ABOUT 700 FEET HIGH EXTENDS ALONG THE COAST. TELLER QUADRANGLE. SCALE 1:250,000. CONTOUR INTERVAL 200 FEET.

MAP 9. ORIENTED THAW LAKES OF THE ARCTIC COASTAL PLAIN. LAKES ARE ELONGATED AT RIGHT ANGLES TO THE DIRECTION OF THE PREVAILING WIND. BARROW QUADRANGLE. SCALE 1:250,000.



MAP 10. TOPOGRAPHY OF THE CENTRAL BROOKS RANGE, A MYRIAD OF SHARP GLACIATED RIDGES WITH ACCORDANT SUMMITS AT 6,500--7,500 FEET. THE STRONG EASTERLY GRAIN OF THE TOPOGRAPHY REFLECTS THE STRUCTURE OF PALEOZOIC SEDIMENTARY ROCKS. THE LOW COUNTRY IN THE NORTHWEST CORNER OF THE MAP IS PART OF THE ARCTIC FOOTHILLS PROVINCE. PHILIP SMITH MOUNTAINS QUADRANGLE. SCALE 1:250,000. CONTOUR INTERVAL 200 FEET.

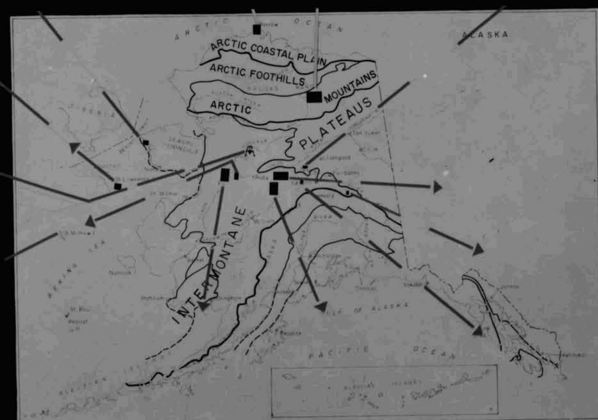


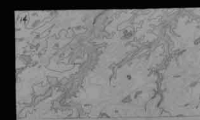
MAP 11. ASYMMETRIC RIDGES IN WESTERN YUKON-TANANA UPLAND. THE RIDGES RESEMBLE CUESTAS ON SOUTH-DIPPING BEDS. HOWEVER, THE BEDS ARE NEARLY VERTICAL. PATCHES OF GRAVEL ON THE GENTLE SOUTH-FACING SLOPES CAME FROM SOURCES AT THE HEADS OF SOUTHWEST-FLOWING STREAMS AND INDICATE THAT THESE STREAMS MIGRATED INTO THEIR SOUTH BANKS AS THEY CUT THEIR VALLEYS. PERHAPS MORE ACTIVE SOLIFLUCTION ON THE SOUTH-FACING SLOPES PUSHED THE STREAMS SOUTHWARD, AND THE SHADED AND FROZEN SOUTH BANKS WERE MORE EASILY ERODED THAN THE NORTH BANKS. TANANA A-1 QUADRANGLE. SCALE 1:63,360. CONTOUR INTERVAL 100 FEET.

ARCTIC PLAINS AND MOUNTAINS

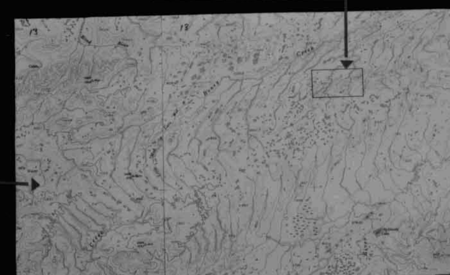
INTERMONTANE PLATEAUS

PHOTO 11. VIEW SOUTH ACROSS THE NORTH END OF THE KOYUKUK FLATS SHOWING MEANDERS AND MEANDER SCROLLS OF THE KOYUKUK RIVER. TERRACE DOTTED WITH THAW LAKES IN THE LEFT DISTANCE IS 50--100 FEET HIGHER THAN THE RIVER. THE STRAIGHT TERRACE FRONT MAY MARK AN ACTIVE FAULT. PHOTOGRAPH BY U. S. AIR FORCE.

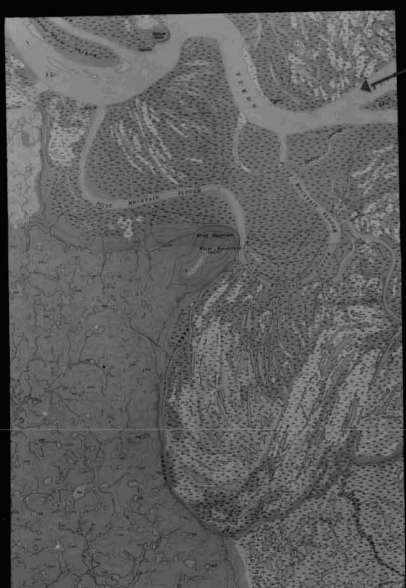




MAP 14. DETAILED TOPOGRAPHY OF PART OF THE AREA SHOWN BELOW. THE INTRICATE GULLYING ON THE WALLS OF THE CANYONS IS CHARACTERISTIC OF EROSION IN POORLY CONSOLIDATED ROCKS. KANTISHNA RIVER D-5 QUADRANGLE. SCALE 1:63,360. CONTOUR INTERVAL 50 FEET.

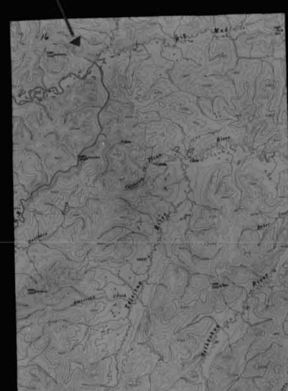


MAP 13. ANOMALOUS DRAINAGE AT THE EASTERN END OF THE NOWITNA LOWLANDS. THESE PARALLEL MINOR TRIBUTARIES OF THE CHITANANA AND LITTLE MUD RIVERS AND BONEY CREEK ARE INCISED IN A DUNE-COVERED SILT PLAIN. THEIR PARALLEL COURSES, WHICH ARE AT A CONSIDERABLE ANGLE TO THE TREND OF THE DUNES AND WHICH DO NOT SEEM TO BE DUE TO ANY BEDROCK STRUCTURE, MAY BE CONSEQUENT UPON THE FLANKS OF A QUATERNARY UPWARP. RUBY AND KANTISHNA RIVER QUADRANGLES. SCALE 1:250,000. CONTOUR INTERVAL 200 FEET.

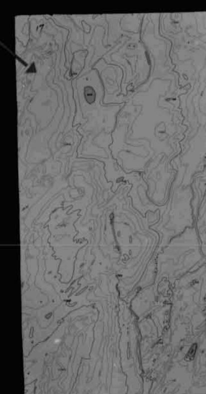


MAP 12. FLOOD PLAIN WITH MEANDER-SCROLL LAKES (A) AND THAW LAKES (B), INCISED IN A ROLLING SILT PLAIN WITH THAW LAKES AND SINKS (C). KOYUKUK FLATS, JUST EAST OF THE JUNCTION OF THE YUKON AND KOYUKUK RIVERS. BISHOP ROCK AND PILOT MOUNTAIN ARE ISOLATED HILLS OF SEDIMENTARY ROCKS AND GRANITOID INTRUSIONS. NULATO C-3 AND D-3 QUADRANGLES. SCALE 1:63,360. CONTOUR INTERVAL 50 FEET.

MAP 15. PARALLEL STREAMS AND RIDGES IN SANDSTONE AND SHALE OF CRETACEOUS AGE IN THE NULATO HILLS. RIVERS FOLLOW FAULTS THAT STRIKE N. 45° E. BEDS AND FOLD AXES STRIKE ABOUT N. 30° E. NULATO QUADRANGLE. SCALE 1:250,000. CONTOUR INTERVAL 200 FEET.



MAP 16. THE NORTHEASTERN KUSKOKWIM MOUNTAINS--TOPOGRAPHY TYPICAL OF INTERIOR UPLANDS--GENTLE RIDGES WITH ROUNDED CRESTS; FLAT-FLOORED VALLEYS OF MEANDERING STREAMS; V-SHAPED CANYONS OF MINOR TRIBUTARIES. RUBY QUADRANGLE. SCALE 1:250,000. CONTOUR INTERVAL 200 FEET.



MAP 17. TRANSVERSE SAND DUNES IN THE NORTHWEST TANANA-KUSKOKWIM LOWLAND. WIND WAS FROM THE NORTHEAST. KANTISHNA RIVER C-2 QUADRANGLE. SCALE 1:63,360. CONTOUR INTERVAL 50 FEET.

MAP 18. LATE WISCONSIN END MORAINE AND OUTWASH PLAINS ON THE SOUTH SIDE OF THE EASTERN TANANA-KUSKOKWIM LOWLAND. BIG DELTA A-5 QUADRANGLE. SCALE 1:63,360. CONTOUR INTERVAL 50 FEET.

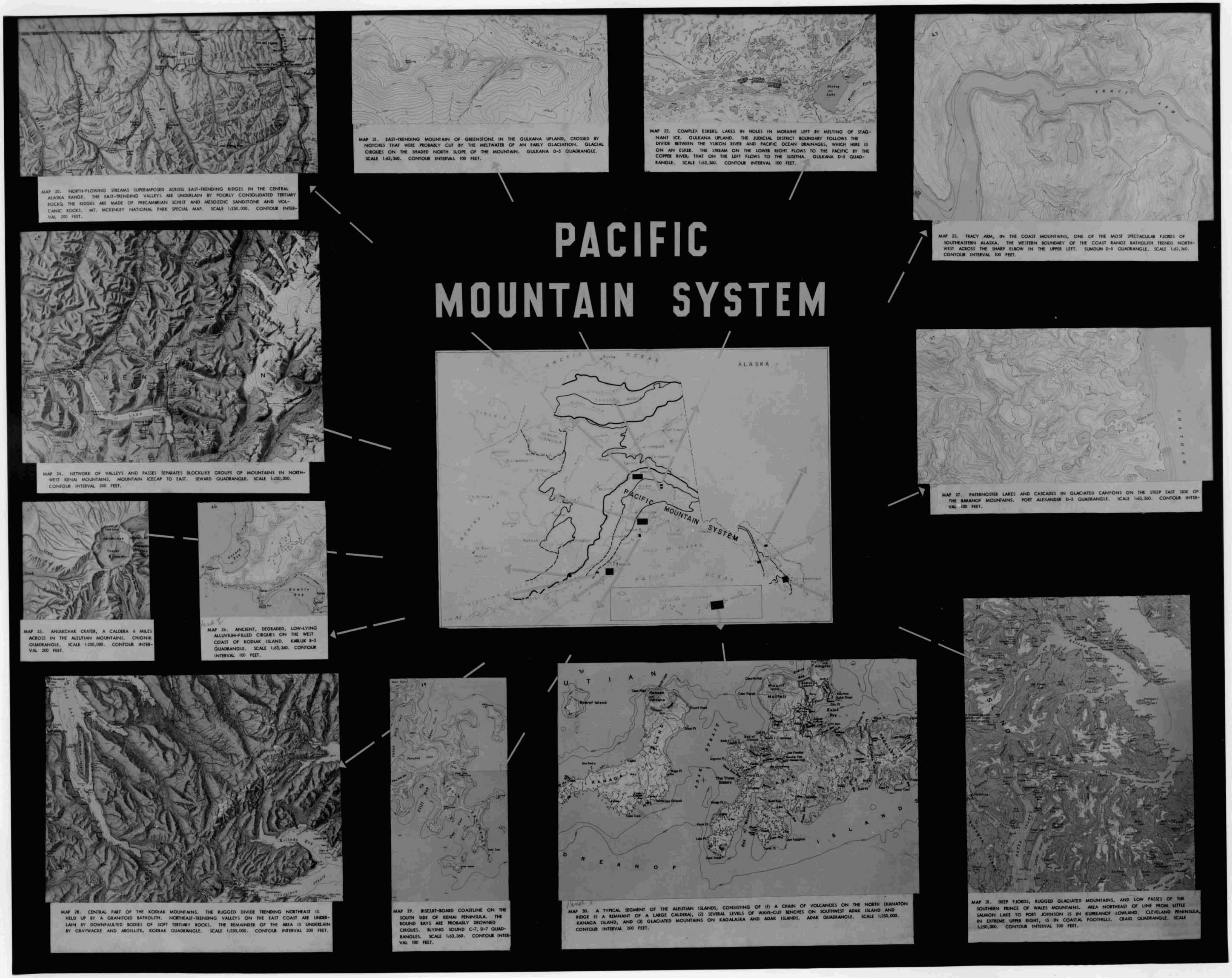

PACIFIC MOUNTAIN SYSTEM
MAP 20. NORTH-FLOWING STREAMS SUPERIMPOSED ACROSS EAST-TRENDING RIDGES IN THE CENTRAL ALASKA RANGE. THE EAST-TRENDING VALLEYS ARE UNDERLAIN BY POORLY CONSOLIDATED TERTIARY ROCKS; THE RIDGES ARE MADE OF PRECAMBRIAN SCHIST AND MESOZOIC SANDSTONE AND VOLCANIC ROCKS. MT. MCKINLEY NATIONAL PARK SPECIAL MAP. SCALE 1:250,000. CONTOUR INTERVAL 200 FEET.
MAP 21. EAST-TRENDING MOUNTAIN OF GREENSTONE IN THE GULKANA UPLAND, CROSSED BY NOTCHES THAT WERE PROBABLY CUT BY THE MELTWATER OF AN EARLY GLACIATION. GLACIAL CIRQUES ON THE SHADED NORTH SLOPE OF THE MOUNTAIN. GULKANA D-5 QUADRANGLE. SCALE 1:63,360. CONTOUR INTERVAL 100 FEET.
MAP 22. COMPLEX ESKERS; LAKES IN HOLES IN MORAINE LEFT BY MELTING OF STAGNANT ICE. GULKANA UPLAND. THE JUDICIAL DISTRICT BOUNDARY FOLLOWS THE DIVIDE BETWEEN THE YUKON RIVER AND PACIFIC OCEAN DRAINAGES, WHICH HERE IS ON AN ESKER. THE STREAM ON THE LOWER RIGHT FLOWS TO THE PACIFIC BY THE COPPER RIVER; THAT ON THE LEFT FLOWS TO THE SUSITNA. GULKANA D-5 QUADRANGLE. SCALE 1:63,360. CONTOUR INTERVAL 100 FEET.
MAP 23. TRACY ARM, IN THE COAST MOUNTAINS, ONE OF THE MOST SPECTACULAR FJORDS OF SOUTHEASTERN ALASKA. THE WESTERN BOUNDARY OF THE COAST RANGE BATHOLITH TRENDS NORTHWEST ACROSS THE SHARP ELBOW IN THE UPPER LEFT. SUMDUM D-5 QUADRANGLE. SCALE 1:63,360. CONTOUR INTERVAL 100 FEET.
MAP 24. NETWORK OF VALLEYS AND PASSES SEPARATES BLOCKLIKE GROUPS OF MOUNTAINS IN NORTHWEST KENAI MOUNTAINS. MOUNTAIN ICECAP TO EAST. SEWARD QUADRANGLE. SCALE 1:250,000. CONTOUR INTERVAL 200 FEET.
MAP 25. ANIAKCHAK CRATER, A CALDERA 6 MILES ACROSS IN THE ALEUTIAN MOUNTAINS. CHIGNIK QUADRANGLE. SCALE 1:250,000. CONTOUR INTERVAL 200 FEET.
MAP 26. ANCIENT, DEGRADED, LOW-LYING ALLUVIUM-FILLED CIRQUES ON THE WEST COAST OF KODIAK ISLAND. KARLUK B-3 QUADRANGLE. SCALE 1:63,360. CONTOUR INTERVAL 100 FEET.
MAP 27. PATERNOSTER LAKES AND CASCADES IN GLACIATED CANYONS ON THE STEEP EAST SIDE OF THE BARANOF MOUNTAINS. PORT ALEXANDER D-3 QUADRANGLE. SCALE 1:63,360. CONTOUR INTERVAL 100 FEET.
MAP 28. CENTRAL PART OF THE KODIAK MOUNTAINS. THE RUGGED DIVIDE TRENDING NORTHEAST IS HELD UP BY A GRANITOID BATHOLITH. NORTHEAST-TRENDING VALLEYS ON THE EAST COAST ARE UNDERLAIN BY DOWNFAULTED BODIES OF SOFT TERTIARY ROCKS. THE REMAINDER OF THE AREA IS UNDERLAIN BY GRAYWACKE AND ARGILLITE. KODIAK QUADRANGLE. SCALE 1:250,000. CONTOUR INTERVAL 200 FEET.
MAP 29. BISCUIT-BOARD COASTLINE ON THE SOUTH SIDE OF KENAI PENINSULA. THE ROUND BAYS ARE PROBABLY DROWNED CIRQUES. BLYING SOUND C-7, D-7 QUADRANGLES. SCALE 1:63,360. CONTOUR INTERVAL 100 FEET.
MAP 30. A TYPICAL SEGMENT OF THE ALEUTIAN ISLANDS, CONSISTING OF (1) A CHAIN OF VOLCANOES ON THE NORTH (KANATON RIDGE IS A REMNANT OF A LARGE CALDERA), (2) SEVERAL LEVELS OF WAVE-CUT BENCHES ON SOUTHWEST ADAK ISLAND AND KANAGA ISLAND, AND (3) GLACIATED MOUNTAINS ON KAGALASKA AND ADAK ISLANDS. ADAK QUADRANGLE. SCALE 1:250,000. CONTOUR INTERVAL 200 FEET.
MAP 31. DEEP FJORDS, RUGGED GLACIATED MOUNTAINS, AND LOW PASSES OF THE SOUTHERN PRINCE OF WALES MOUNTAINS. AREA NORTHEAST OF LINE FROM LITTLE SALMON LAKE TO PORT JOHNSON IS IN KUPREANOF LOWLAND. CLEVELAND PENINSULA, IN EXTREME UPPER RIGHT, IS IN COASTAL FOOTHILLS. CRAIG QUADRANGLE. SCALE 1:250,000. CONTOUR INTERVAL 200 FEET.

PHOTO 12. MOUNTAINS OF THE ALASKA RANGE. CLIFFS IN FOREGROUND, WHICH DROP 5,000 FEET, ARE OF GRANITE, CAPPED BY OLDER METAMORPHIC ROCKS, VISIBLE ON MOUNTAIN TOP AT RIGHT. MT. HUNTER, 14,580 FEET HIGH, OF GRANITE, IN THE DISTANCE. VIEW WEST FROM OVER THE RUTH GLACIER. PHOTOGRAPH BY BRADFORD WASHBURN.

PHOTO 13. THE ALASKA RANGE NORTHEAST OF MT. MCKINLEY (20,269 FEET). SEVEN NORTH-FLOWING RIVERS WERE SUPERIMPOSED ACROSS EAST-TRENDING BELTS OF HARD ROCKS (RIGHT) AND SOFT TERTIARY ROCKS THAT UNDERLIE THE LINE OF PLAINS AND PASSES EXTENDING FROM THE LEFT OF THE PICTURE TOWARD THE BASE OF MT. MCKINLEY. THE NORTHERN LIMIT OF THE PLEISTOCENE CORDILLERAN ICE SHEET IS IN THE PICTURE. GLACIERS FROM MOUNTAINS ON THE LEFT EXTENDED NORTH DOWN THE VALLEYS, BUT THE MOUNTAINS ON THE RIGHT WERE NOT GLACIATED. THE PLAIN IN THE RIGHT DISTANCE IS LESS THAN 2,000 FEET ABOVE SEA LEVEL. VIEW SOUTHWEST TO MT. MCKINLEY. PHOTOGRAPH BY BRADFORD WASHBURN.

PHOTO 14. PLEISTOCENE VOLCANOES OF THE WESTERN WRANGELL MOUNTAINS. MT. DRUM (12,002 FEET) ON LEFT, MT. SANFORD (16,208 FEET) IN CENTER, AND MT. WRANGELL (14,005 FEET), STILL ACTIVE, ON RIGHT. DEFORMED PALEOZOIC AND MESOZOIC SEDIMENTARY AND VOLCANIC ROCKS ARE EXPOSED IN THE LOW MOUNTAINS AT THEIR BASE. THE BLUFFS OF THE COPPER RIVER, IN MIDDLE DISTANCE, ARE OF PLEISTOCENE GLACIAL AND LAKE DEPOSITS AND INTERBEDDED VOLCANIC MUDFLOWS OF THE COPPER RIVER LOWLAND. RICHARDSON HIGHWAY AND TONSINA RIVER IN FOREGROUND. PHOTOGRAPH BY BRADFORD WASHBURN.

PHOTO 15. THE MALASPINA GLACIER AND THE SOUTH FRONT OF THE ST. ELIAS MOUNTAINS. MT. ST. ELIAS (18,008 FEET), AT THE LEFT, RISES 16,000--17,000 FEET ABOVE THE GLACIER SURFACE IN THE FOREGROUND. THE PATTERN OF INTENSELY DEFORMED SUPERGLACIAL MORAINES IS CHARACTERISTIC OF GLACIERS THAT EMERGE ONTO BROAD LOWLANDS. PHOTOGRAPH BY BRADFORD WASHBURN.

PACIFIC MOUNTAIN SYSTEM

PHOTO 16. VIEW NORTH ACROSS THE LOWER MATANUSKA VALLEY, COOK INLET-SUSITNA LOWLAND. THE MATANUSKA RIVER AND THE TOWN OF PALMER ARE ON THE RIGHT. DIRECTLY ABOVE THE RIVER, AT THE BASE OF THE MOUNTAINS, IS WISHBONE HILL, A SYNCLINAL MOUNTAIN OF CONGLOMERATE, THE CENTER OF A MAJOR COAL FIELD. A COMPLEX SYSTEM OF ESKERS AND CREVASSE FILLINGS IN CENTER FOREGROUND PASSES INTO AN OUTWASH PLAIN ON THE LEFT. THE FARMS ARE ON A RICH LOESS SOIL THINNING WESTWARD FROM THE MATANUSKA RIVER. THE FRONT OF THE TALKEETNA MOUNTAINS IN THE BACKGROUND IS A LARGE FAULT LINE SCARP. A DISSECTED SURFACE OF LOW RELIEF CAPS RIDGES ON THE LEFT AND SLOPES WESTWARD BENEATH TERTIARY SEDIMENTS IN THE SUSITNA VALLEY. MT. MCKINLEY, 120 MILES AWAY AND 20,269 FEET HIGH, AT LEFT HORIZON. PHOTOGRAPH BY U. S. AIR FORCE.

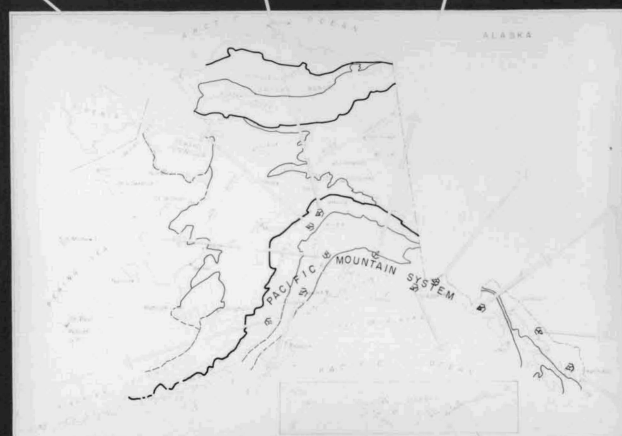


PHOTO 17. FAIRWEATHER RANGE, IN THE BACKGROUND, TOWERS OVER THE ALSEK RANGES IN THE FOREGROUND. MT. LA PEROUSE (10,728 FEET), LEFT OF CENTER, AND MT. CRILLON (12,726 FEET), NEAR RIGHT, ON SKYLINE. GIEKIE GLACIER, IN CENTER FOREGROUND, IS SURROUNDED BY MOUNTAINS 4,500 FEET HIGH. VIEW WEST FROM OVER GLACIER BAY. PHOTOGRAPH BY R. S. SARGENT, 1929.

PHOTO 18. COAST MOUNTAINS. THE SUMMIT UPLAND, OF GRANITOID ROCKS, IS ABOUT 6,000 FEET HIGH, AND THE SHARP PEAKS ON THE SKYLINE RISE TO ABOUT 8,000--8,400 FEET. VIEW SOUTHEAST FROM THE HEAD OF ENDICOTT ARM UP THE DAWES GLACIER. PHOTOGRAPH BY R. S. SARGENT, 1929.

PHOTO 19. GLACIALLY SCULPTURED TOPOGRAPHY ON GENTLY DIPPING JURASSIC SANDSTONE IN THE EASTERN ALEUTIAN MOUNTAINS. GULLIES FOLLOW FAULTS AND JOINTS. MT. DOUGLAS AND FOURPEAKED MOUNTAIN, TWO ACTIVE VOLCANOES, IN THE DISTANCE. KAMISHAK BAY, AN ARM OF COOK INLET, ON THE LEFT. PHOTOGRAPH BY U. S. AIR FORCE.

PHOTO 20. ABANDONED MARGINAL DRAINAGEWAY ON THE NORTH SIDE OF KENAI PENINSULA, COOK INLET-SUSITNA LOWLAND. TINY STREAMS MEANDER THROUGH THESE NARROW WINDING MARSH-COVERED PLAINS, WHICH WERE PRESUMABLY CARVED BY MELTWATER DURING THE WASTING OF A LATE PLEISTOCENE ICE SHEET WHEN ICE STILL FILLED COOK INLET. MT. REDOUBT (10,197 FEET), AND MT. ILIAMNA (10,016 FEET), VOLCANOES OF THE SOUTHERN ALASKA RANGE, RISE ON THE HORIZON BEYOND COOK INLET. PHOTOGRAPH BY U. S. AIR FORCE.

PHOTO 21. SOUTH FACE OF THE ROBINSON MOUNTAINS, 5,500--6,500 FEET HIGH, WITH COASTAL PLAIN AND MARINE TERRACES, IN THE GULF OF ALASKA COASTAL BELT. SOFT TERTIARY ROCKS ON THE SOUTH LIMB OF A BROAD SYNCLINE ARE EXPOSED IN THE MOUNTAIN FRONT. SOME OF THE DARK BANDS ARE MARINE TILLITE. BERING GLACIER IS IN LEFT DISTANCE, AND THE HIGH MOUNTAINS OF THE CHIGACH RANGE IN CENTER DISTANCE. VIEW WEST FROM NORTH OF ICY CAPE. PHOTOGRAPH BY BRADFORD WASHBURN.

PHOTO 22. ROUNDED MOUNTAINS WITH HUMMOCKY SUMMITS AND ROCK-BASIN LAKES IN THE COASTAL FOOTHILLS, ONCE BURIED BY PLEISTOCENE ICE SHEETS. VIEW WEST OVER EASTERN REVILLAGIGEDO ISLAND, SOUTHEASTERN ALASKA. PHOTOGRAPH BY R. S. SARGENT, 1929.

PHOTO 1. MOUNTAINS CARVED IN MILDLY METAMORPHOSED SEDIMENTARY ROCKS OF PALEOZOIC AGE, SOUTHERN BROOKS RANGE. LOOKING WEST ACROSS THE SOUTHERN JOHN RIVER. OFFICIAL U. S. NAVY PHOTOGRAPH.

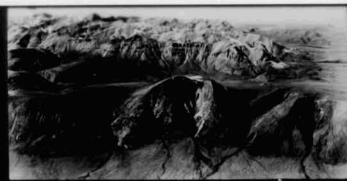


PHOTO 2. GLACIATED MOUNTAINS CARVED IN RECUMBENT FOLDS AND OVERTHRUST PLATES OF PALEOZOIC ROCKS, CHIEFLY LIMESTONE OF MISSISSIPPIAN AGE, NORTHERN BROOKS RANGE. LOOKING WEST FROM OVER THE ITKILLIK RIVER. OFFICIAL U. S. NAVY PHOTOGRAPH.

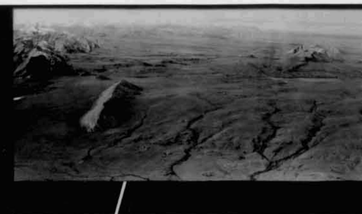
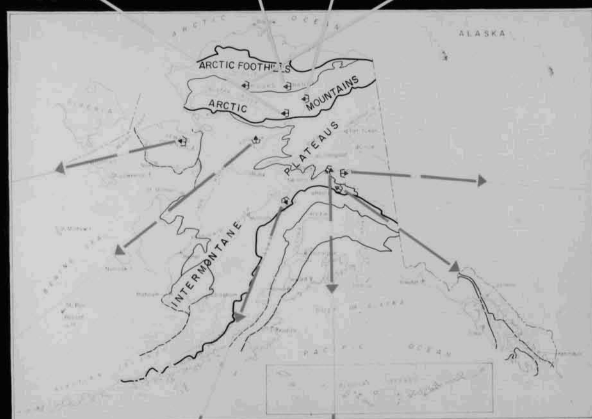


PHOTO 3. NORTH FRONT OF THE BROOKS RANGE AND THE PLAINS AND PEDIMENTS OF THE SOUTHERN SECTION OF THE ARCTIC FOOTHILLS. ISOLATED MOUNTAINS OF MISSISSIPPIAN LIMESTONE RISE FROM ROLLING TUNDRA PLAINS CARVED ON HIGHLY DEFORMED YET SOFT LATE PALEOZOIC AND MESOZOIC ROCKS. MORAINE DEPOSITED BY THE ANAKTUVUK GLACIER IN LATE PLEISTOCENE TIME, IN RIGHT FOREGROUND. LOOKING WEST FROM OVER THE ANAKTUVUK RIVER NEAR ITS HEAD. OFFICIAL U. S. NAVY PHOTOGRAPH.

PHOTO 4. RIDGES SUPPORTED BY RESISTANT ROCKS RISE ABOVE TUNDRA PLAINS CUT ON SOFT ROCKS IN THE TIGHTLY FOLDED SOUTHERN SECTION OF THE ARCTIC FOOTHILLS. LOOKING WEST FROM OVER THE ETIVILUK RIVER. OFFICIAL U. S. NAVY PHOTOGRAPH.

ARCTIC MOUNTAINS AND FOOTHILLS

INTERMONTANE PLATEAUS



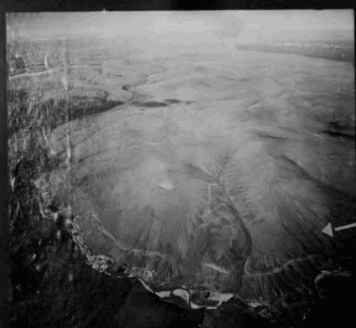


PHOTO 5. GENTLY UNDULATING UPLAND SURFACES AND SHARP V-SHAPED CANYONS TYPICAL OF THE UPLANDS OF NORTHERN SEWARD PENINSULA. ESCARPMENTS ALONG VALLEY IN FOREGROUND ARE EDGES OF DISSECTED INTER-VALLEY LAVA FLOW. FINELY ETCHED GULLIES ON NEARBY SLOPES ARE CUT IN LOESS WHICH BLANKETS MOST OF THE UPLAND SURFACE. PLACER MINES ALONG RIVER. LOOKING WEST ACROSS VALLEY OF INMACHUK RIVER, ABOUT 20 MILES SOUTH OF DEERING. GOODHOPE BAY IN UPPER RIGHT CORNER. PHOTOGRAPH BY U. S. AIR FORCE.

PHOTO 6. ROUNDED MOUNTAINS WITH GENTLY SLOPING SIDES, NARROW ALLUVIUM-FLOORED VALLEYS, AND V-SHAPED TRIBUTARY GULCHES, FEATURES OF UPLAND AREAS THROUGHOUT INTERIOR ALASKA, SOUTHERN PART OF THE YUKON-TANANA UPLAND. RELIEF IS ABOUT 1,500—2,000 FEET. BEDROCK IS NORTHEAST-STRIKING PRECAMBRIAN SCHIST. VIEW EAST UP THE CHENA RIVER. PHOTOGRAPH BY U. S. AIR FORCE.

PHOTO 7. A COMPACT HIGHLAND ABOUT 4,000 FEET HIGH IN THE PAH RIVER SECTION. THE SHARP CRESTED HIGHER RIDGES, GLACIATED IN PRE-WISCONSIN TIME, HAVE BEEN MODIFIED BY PERIGLACIAL MASS-WASTING IN LATER COLD PERIODS; MORAINAL TOPOGRAPHY HAS BEEN DESTROYED. THE SMOOTH ROUNDED RIDGES AND V-SHAPED CANYONS OF THE LOWER HILLS WERE SCULPTURED LARGELY BY MASS-WASTING. THE LAKE-DOTTED PAH RIVER FLATS ARE BEYOND THE HILLS. VIEW NORTH ALONG THE ZANE HILLS. PHOTOGRAPH BY U. S. AIR FORCE.

PHOTO 8. BRAIDED STREAM ON AN OUTWASH FAN IN THE SOUTHERN PART OF THE TANANA-KUSKOKWIM LOWLAND, NORTHWEST OF MT. MCKINLEY. PHOTOGRAPH BY BRADFORD WASHBURN.

PHOTO 9. GOLD DREDGING IN A VALLEY IN THE YUKON-TANANA UPLAND NEAR FAIRBANKS. NOTICE THE ROUNDED CRESTS AND SMOOTH GENTLE SLOPES OF THE BEDROCK HILLS. THEIR LOWER SLOPES ARE THICKLY MANTLED WITH LOESS, IN WHICH SHALLOW GULLIES WERE CUT (MARKED BY LINES OF ASPENS). THE BANKS OF THE DREDGE AREA ARE FORMED OF FROZEN SILT AND "MUCK", WHICH MUST BE REMOVED BY HYDRAULICKING BEFORE THE GOLD-BEARING GRAVELS CAN BE THAWED AND DREDGED. PHOTOGRAPH BY BRADFORD WASHBURN.

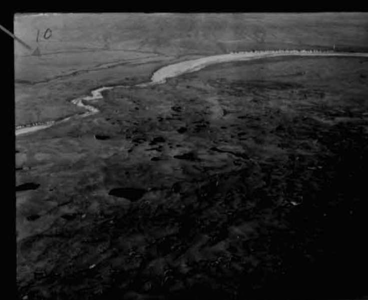


PHOTO 10. END MORAINE ON THE LITTLE DELTA RIVER, SOUTHEAST PART OF THE TANANA-KUSKOKWIM LOWLAND, SHOWING IRREGULAR TOPOGRAPHY OF MOUNDS AND WATER-FILLED HOLLOWS. VIEW NORTHWEST ACROSS MORAINE. PHOTOGRAPH BY BRADFORD WASHBURN.

PACIFIC MOUNTAIN SYSTEM

PHOTO 12. MOUNTAINS OF THE ALASKA RANGE. CLIFFS IN FOREGROUND, WHICH DROP 5,000 FEET, ARE OF GRANITE, CAPPED BY OLDER METAMORPHIC ROCKS, VISIBLE ON MOUNTAIN TOP AT RIGHT. MT. HUNTER, 14,580 FEET HIGH, OF GRANITE, IN THE DISTANCE. VIEW WEST FROM OVER THE RUTH GLACIER. PHOTOGRAPH BY BRADFORD WASHBURN.

PHOTO 13. THE ALASKA RANGE NORTHEAST OF MT. MCKINLEY (20,269 FEET). SEVEN NORTH-FLOWING RIVERS WERE SUPERIMPOSED ACROSS EAST-TRENDING BELTS OF HARD ROCKS (RIGHT) AND SOFT TERTIARY ROCKS THAT UNDERLIE THE LINE OF PLAINS AND PASSES EXTENDING FROM THE LEFT OF THE PICTURE TOWARD THE BASE OF MT. MCKINLEY. THE NORTHERN LIMIT OF THE PLEISTOCENE CORDILLERAN ICE SHEET IS IN THE PICTURE. GLACIERS FROM MOUNTAINS ON THE LEFT EXTENDED NORTH DOWN THE VALLEYS, BUT THE MOUNTAINS ON THE RIGHT WERE NOT GLACIATED. THE PLAIN IN THE RIGHT DISTANCE IS LESS THAN 2,000 FEET ABOVE SEA LEVEL. VIEW SOUTHWEST TO MT. MCKINLEY. PHOTOGRAPH BY BRADFORD WASHBURN.

PHOTO 14. PLEISTOCENE VOLCANOES OF THE WESTERN WRANGELL MOUNTAINS. MT. DRUM (12,002 FEET) ON LEFT, MT. SANFORD (16,208 FEET) IN CENTER, AND MT. WRANGELL (14,005 FEET), STILL ACTIVE, ON RIGHT. DEFORMED PALEOZOIC AND MESOZOIC SEDIMENTARY AND VOLCANIC ROCKS ARE EXPOSED IN THE LOW MOUNTAINS AT THEIR BASE. THE BLUFFS OF THE COPPER RIVER, IN MIDDLE DISTANCE, ARE OF PLEISTOCENE GLACIAL AND LAKE DEPOSITS AND INTERBEDDED VOLCANIC MUDFLOWS OF THE COPPER RIVER LOWLAND. RICHARDSON HIGHWAY AND TONSINA RIVER IN FOREGROUND. PHOTOGRAPH BY BRADFORD WASHBURN.

PHOTO 15. THE MALASPINA GLACIER AND THE SOUTH FRONT OF THE ST. ELIAS MOUNTAINS. MT. ST. ELIAS (18,008 FEET), AT THE LEFT, RISES 16,000--17,000 FEET ABOVE THE GLACIER SURFACE IN THE FOREGROUND. THE PATTERN OF INTENSELY DEFORMED SUPERGLACIAL MORAINES IS CHARACTERISTIC OF GLACIERS THAT EMERGE ONTO BROAD LOWLANDS. PHOTOGRAPH BY BRADFORD WASHBURN.

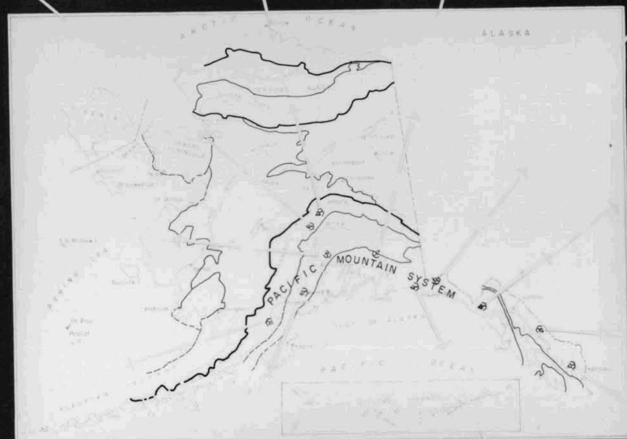


PHOTO 16. VIEW NORTH ACROSS THE LOWER MATANUSKA VALLEY, COOK INLET-SUSITNA LOWLAND. THE MATANUSKA RIVER AND THE TOWN OF PALMER ARE ON THE RIGHT. DIRECTLY ABOVE THE RIVER, AT THE BASE OF THE MOUNTAINS, IS WISHBONE HILL, A SYNCLINAL MOUNTAIN OF CONGLOMERATE, THE CENTER OF A MAJOR COAL FIELD. A COMPLEX SYSTEM OF ESKERS AND CREVASSE FILLINGS IN CENTER FOREGROUND PASSES INTO AN OUTWASH PLAIN ON THE LEFT. THE FARMS ARE ON A RICH LOESS SOIL THINNING WESTWARD FROM THE MATANUSKA RIVER. THE FRONT OF THE TALKEETNA MOUNTAINS IN THE BACKGROUND IS A LARGE FAULT LINE SCARP. A DISSECTED SURFACE OF LOW RELIEF CAPS RIDGES ON THE LEFT AND SLOPES WESTWARD BENEATH TERTIARY SEDIMENTS IN THE SUSITNA VALLEY. MT. MCKINLEY, 120 MILES AWAY AND 20,269 FEET HIGH, AT LEFT HORIZON. PHOTOGRAPH BY U. S. AIR FORCE.

PHOTO 17. FAIRWEATHER RANGE, IN THE BACKGROUND, TOWERS OVER THE ALSEK RANGES IN THE FOREGROUND. MT. LA PEROUSE (10,728 FEET), LEFT OF CENTER, AND MT. CRILLON (12,726 FEET), NEAR RIGHT, ON SKYLINE. GIEKIE GLACIER, IN CENTER FOREGROUND, IS SURROUNDED BY MOUNTAINS 4,500 FEET HIGH. VIEW WEST FROM OVER GLACIER BAY. PHOTOGRAPH BY R. S. SARGENT, 1929.

PHOTO 18. COAST MOUNTAINS. THE SUMMIT UPLAND, OF GRANITOID ROCKS, IS ABOUT 6,000 FEET HIGH, AND THE SHARP PEAKS ON THE SKYLINE RISE TO ABOUT 8,000--8,400 FEET. VIEW SOUTHEAST FROM THE HEAD OF ENDICOTT ARM UP THE DAWES GLACIER. PHOTOGRAPH BY R. S. SARGENT, 1929.

PHOTO 19. GLACIALLY SCULPTURED TOPOGRAPHY ON GENTLY DIPPING JURASSIC SANDSTONE IN THE EASTERN ALEUTIAN MOUNTAINS. GULLIES FOLLOW FAULTS AND JOINTS. MT. DOUGLAS AND FOURPEAKED MOUNTAIN, TWO ACTIVE VOLCANOES, IN THE DISTANCE. KAMISHAK BAY, AN ARM OF COOK INLET, ON THE LEFT. PHOTOGRAPH BY U. S. AIR FORCE.

PHOTO 20. ABANDONED MARGINAL DRAINAGEWAY ON THE NORTH SIDE OF KENAI PENINSULA, COOK INLET-SUSITNA LOWLAND. TINY STREAMS MEANDER THROUGH THESE NARROW WINDING MARSH-COVERED PLAINS, WHICH WERE PRESUMABLY CARVED BY MELTWATER DURING THE WASTING OF A LATE PLEISTOCENE ICE SHEET WHEN ICE STILL FILLED COOK INLET. MT. REDOUBT (10,197 FEET), AND MT. ILIAMNA (10,016 FEET), VOLCANOES OF THE SOUTHERN ALASKA RANGE, RISE ON THE HORIZON BEYOND COOK INLET. PHOTOGRAPH BY U. S. AIR FORCE.

PHOTO 21. SOUTH FACE OF THE ROBINSON MOUNTAINS, 5,500--6,500 FEET HIGH, WITH COASTAL PLAIN AND MARINE TERRACES, IN THE GULF OF ALASKA COASTAL BELT. SOFT TERTIARY ROCKS ON THE SOUTH LIMB OF A BROAD SYNCLINE ARE EXPOSED IN THE MOUNTAIN FRONT. SOME OF THE DARK BANDS ARE MARINE TILLITE. BERING GLACIER IS IN LEFT DISTANCE, AND THE HIGH MOUNTAINS OF THE CHIGACH RANGE IN CENTER DISTANCE. VIEW WEST FROM NORTH OF ICY CAPE. PHOTOGRAPH BY BRADFORD WASHBURN.

PHOTO 22. ROUNDED MOUNTAINS WITH HUMMOCKY SUMMITS AND ROCK-BASIN LAKES IN THE COASTAL FOOTHILLS, ONCE BURIED BY PLEISTOCENE ICE SHEETS. VIEW WEST OVER EASTERN REVILLAGIGEDO ISLAND, SOUTHEASTERN ALASKA. PHOTOGRAPH BY R. S. SARGENT, 1929.

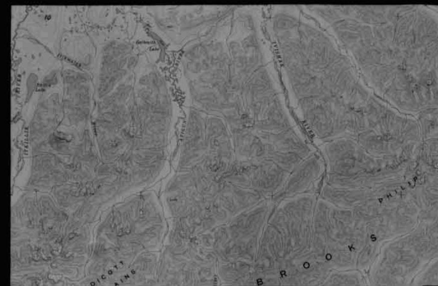
ARCTIC PLAINS AND MOUNTAINS

INTERMONTANE PLATEAUS

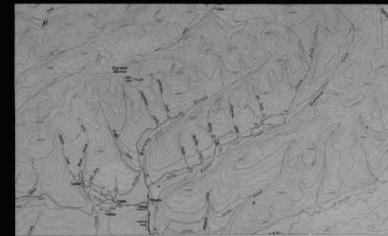
MAP 7. EAST END OF ST. LAWRENCE ISLAND ON THE BERING SHELF. A HILLY UPLAND BORDERED BY WAVE-CUT CLIFFS AND SURROUNDED BY A RAISED MARINE PLATFORM 1-2 MILES WIDE. SCALE 1:250,000. CONTOUR INTERVAL 100 FEET. ST. LAWRENCE ISLAND QUADRANGLE.

MAP 8. THE YORK MOUNTAINS, WEST END OF SEWARD PENINSULA, A SMALL GROUP OF RUGGED MOUNTAINS UNDERLAIN BY CRYSTALLINE LIMESTONE. A MARINE TERRACE ABOUT 700 FEET HIGH EXTENDS ALONG THE COAST. TELLER QUADRANGLE. SCALE 1:250,000. CONTOUR INTERVAL 200 FEET.

MAP 9. ORIENTED THAW LAKES OF THE ARCTIC COASTAL PLAIN. LAKES ARE ELONGATED AT RIGHT ANGLES TO THE DIRECTION OF THE PREVAILING WIND. BARROW QUADRANGLE. SCALE 1:250,000.

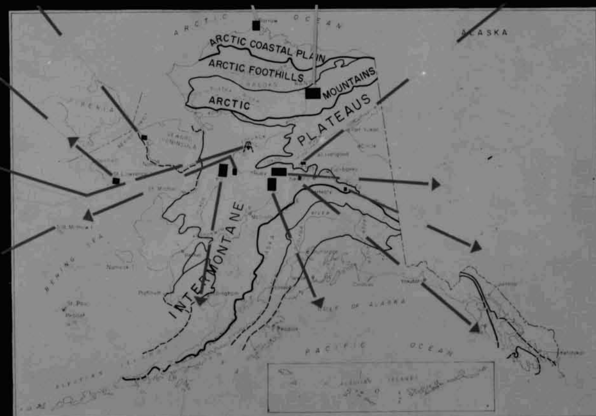


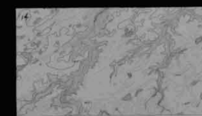
MAP 10. TOPOGRAPHY OF THE CENTRAL BROOKS RANGE, A MYRIAD OF SHARP GLACIATED RIDGES WITH ACCORDANT SUMMITS AT 6,500--7,500 FEET. THE STRONG EASTERLY GRAIN OF THE TOPOGRAPHY REFLECTS THE STRUCTURE OF PALEOZOIC SEDIMENTARY ROCKS. THE LOW COUNTRY IN THE NORTHWEST CORNER OF THE MAP IS PART OF THE ARCTIC FOOTHILLS PROVINCE. PHILIP SMITH MOUNTAINS QUADRANGLE. SCALE 1:250,000. CONTOUR INTERVAL 200 FEET.



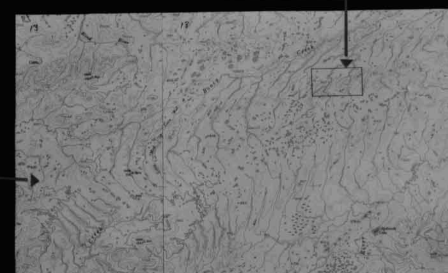
MAP 11. ASYMMETRIC RIDGES IN WESTERN YUKON-TANANA UPLAND. THE RIDGES RESEMBLE CUESTAS ON SOUTH-DIPPING BEDS. HOWEVER, THE BEDS ARE NEARLY VERTICAL. PATCHES OF GRAVEL ON THE GENTLE SOUTH-FACING SLOPES CAME FROM SOURCES AT THE HEADS OF SOUTHWEST-FLOWING STREAMS AND INDICATE THAT THESE STREAMS MIGRATED INTO THEIR SOUTH BANKS AS THEY CUT THEIR VALLEYS. PERHAPS MORE ACTIVE SOLIFLUCTION ON THE SOUTH-FACING SLOPES PUSHED THE STREAMS SOUTHWARD, AND THE SHADED AND FROZEN SOUTH BANKS WERE MORE EASILY ERODED THAN THE NORTH BANKS. TANANA A-1 QUADRANGLE. SCALE 1:63,360. CONTOUR INTERVAL 100 FEET.

PHOTO 11. VIEW SOUTH ACROSS THE NORTH END OF THE KOYUKUK FLATS SHOWING MEANDERS AND MEANDER SCROLLS OF THE KOYUKUK RIVER. TERRACE DOTTED WITH THAW LAKES IN THE LEFT DISTANCE IS 50--100 FEET HIGHER THAN THE RIVER. THE STRAIGHT TERRACE FRONT MAY MARK AN ACTIVE FAULT. PHOTOGRAPH BY U. S. AIR FORCE.

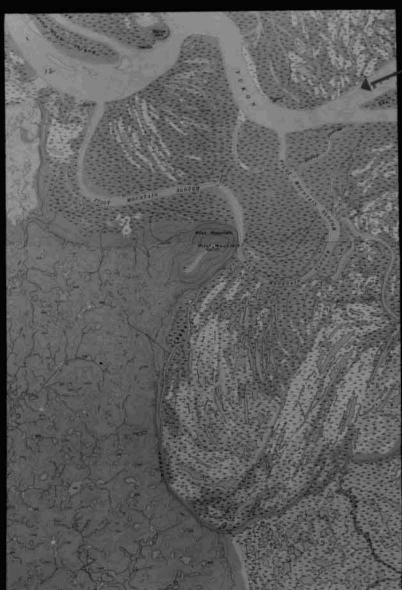




MAP 14. DETAILED TOPOGRAPHY OF PART OF THE AREA SHOWN BELOW. THE INTRICATE GULLYING ON THE WALLS OF THE CANYONS IS CHARACTERISTIC OF EROSION IN POORLY CONSOLIDATED ROCKS. KANTISHNA RIVER D-5 QUADRANGLE. SCALE 1:63,360. CONTOUR INTERVAL 50 FEET.

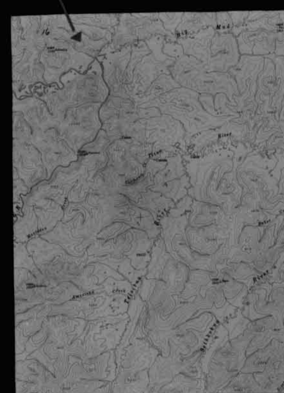


MAP 13. ANOMALOUS DRAINAGE AT THE EASTERN END OF THE NOWITNA LOWLANDS. THESE PARALLEL MINOR TRIBUTARIES OF THE CHITANANA AND LITTLE MUD RIVERS AND BONEY CREEK ARE INCISED IN A DUNE-COVERED SILT PLAIN. THEIR PARALLEL COURSES, WHICH ARE AT A CONSIDERABLE ANGLE TO THE TREND OF THE DUNES AND WHICH DO NOT SEEM TO BE DUE TO ANY BEDROCK STRUCTURE, MAY BE CONSEQUENT UPON THE FLANKS OF A QUATERNARY UPWARP. RUBY AND KANTISHNA RIVER QUADRANGLES. SCALE 1:250,000. CONTOUR INTERVAL 200 FEET.



MAP 12. FLOOD PLAIN WITH MEANDER-SCROLL LAKES (A) AND THAW LAKES (B), INCISED IN A ROLLING SILT PLAIN WITH THAW LAKES AND SINKS (C). KOYUKUK FLATS, JUST EAST OF THE JUNCTION OF THE YUKON AND KOYUKUK RIVERS. BISHOP ROCK AND PILOT MOUNTAIN ARE ISOLATED HILLS OF SEDIMENTARY ROCKS AND GRANITOID INTRUSIONS. NULATO C-3 AND D-3 QUADRANGLES. SCALE 1:63,360. CONTOUR INTERVAL 50 FEET.

MAP 15. PARALLEL STREAMS AND RIDGES IN SANDSTONE AND SHALE OF CRETACEOUS AGE IN THE NULATO HILLS. RIVERS FOLLOW FAULTS THAT STRIKE N. 45° E. BEDS AND FOLD AXES STRIKE ABOUT N. 30° E. NULATO QUADRANGLE. SCALE 1:250,000. CONTOUR INTERVAL 200 FEET.



MAP 16. THE NORTHEASTERN KUSKOKWIM MOUNTAINS--TOPOGRAPHY TYPICAL OF INTERIOR UPLANDS--GENTLE RIDGES WITH ROUNDED CRESTS; FLAT-FLOORED VALLEYS OF MEANDERING STREAMS; V-SHAPED CANYONS OF MINOR TRIBUTARIES. RUBY QUADRANGLE. SCALE 1:250,000. CONTOUR INTERVAL 200 FEET.

MAP 17. TRANSVERSE SAND DUNES IN THE NORTHWEST TANANA-KUSKOKWIM LOWLAND. WIND WAS FROM THE NORTHEAST. KANTISHNA RIVER C-2 QUADRANGLE. SCALE 1:63,360. CONTOUR INTERVAL 50 FEET.

MAP 18. LATE WISCONSIN END MORAINE AND OUTWASH PLAINS ON THE SOUTH SIDE OF THE EASTERN TANANA-KUSKOKWIM LOWLAND. BIG DELTA ~~A-5~~ QUADRANGLE. SCALE 1:63,360. CONTOUR INTERVAL 50 FEET.